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THE
INTERNATIONAL
SUGAR JOURNAL.

A TECHNICAL AND COMMERCIAL PERIODICAL
DEVOTED ENTIRELY TO THE SUGAR INDUSTRY.

JANUARY TO DECEMBER,

1924.

VOLUME XXVI.

LONDON:
ST. DUNSTAN'S HILL, E.C.3.
1924.

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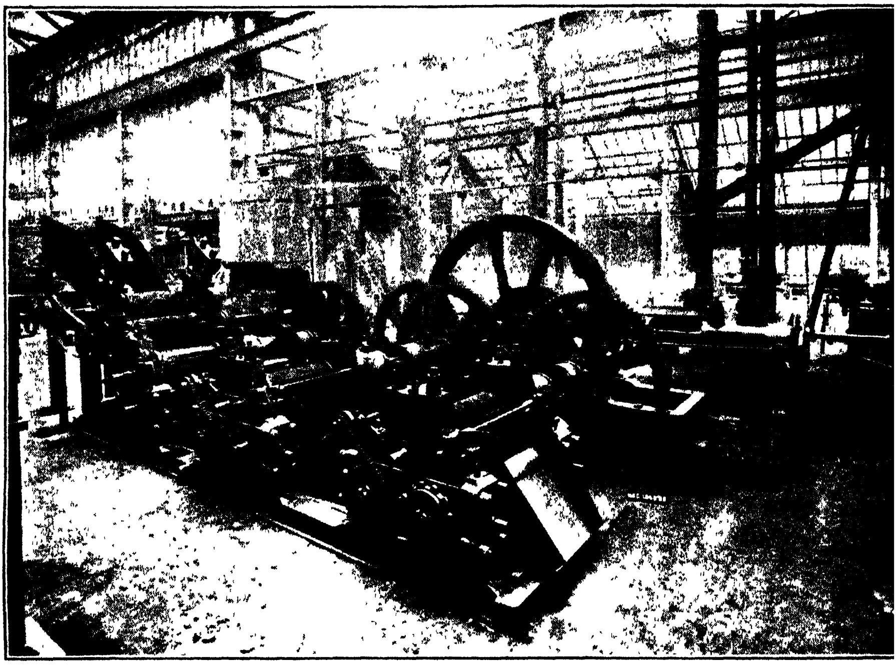

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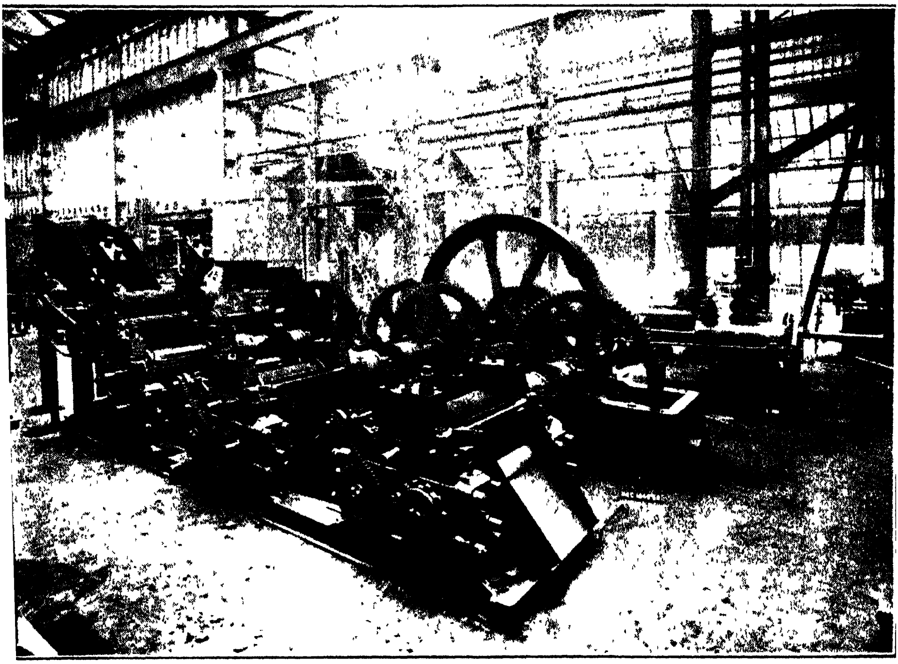

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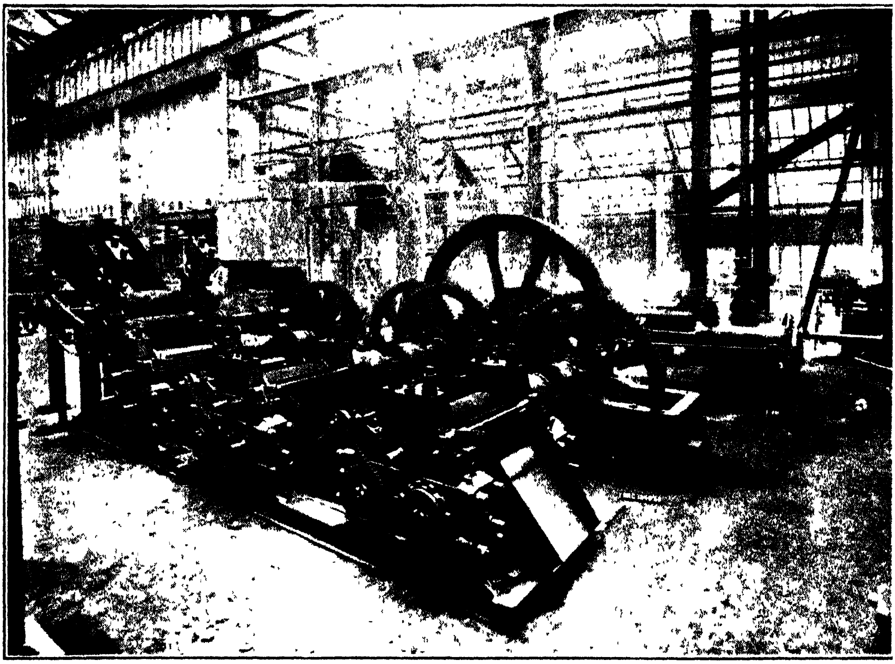

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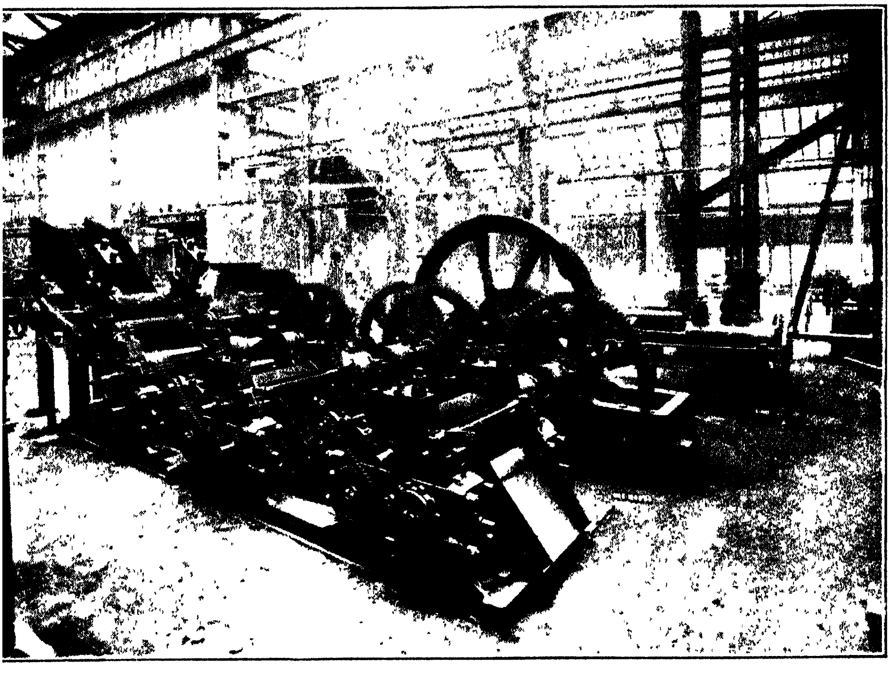

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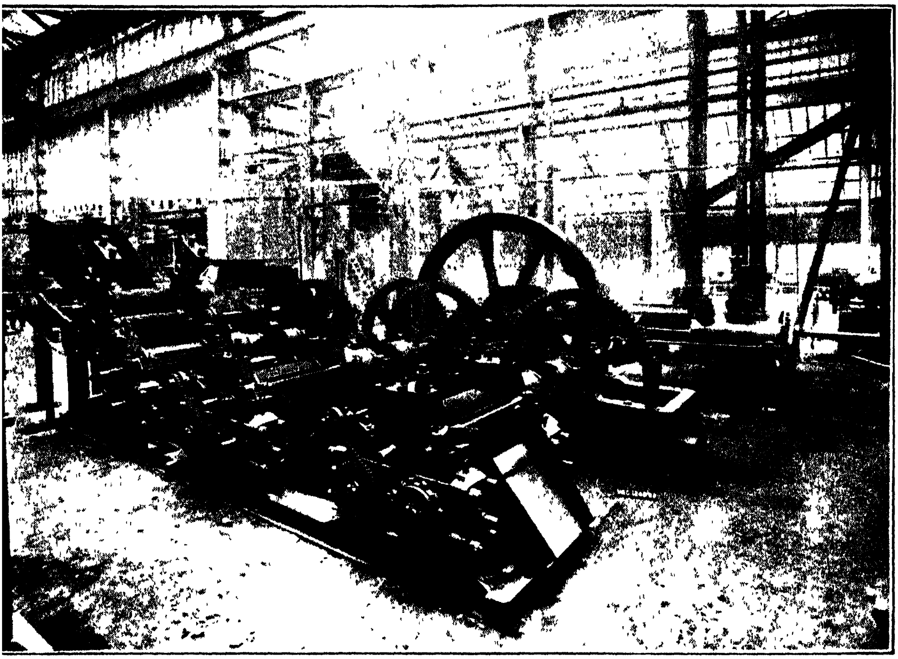

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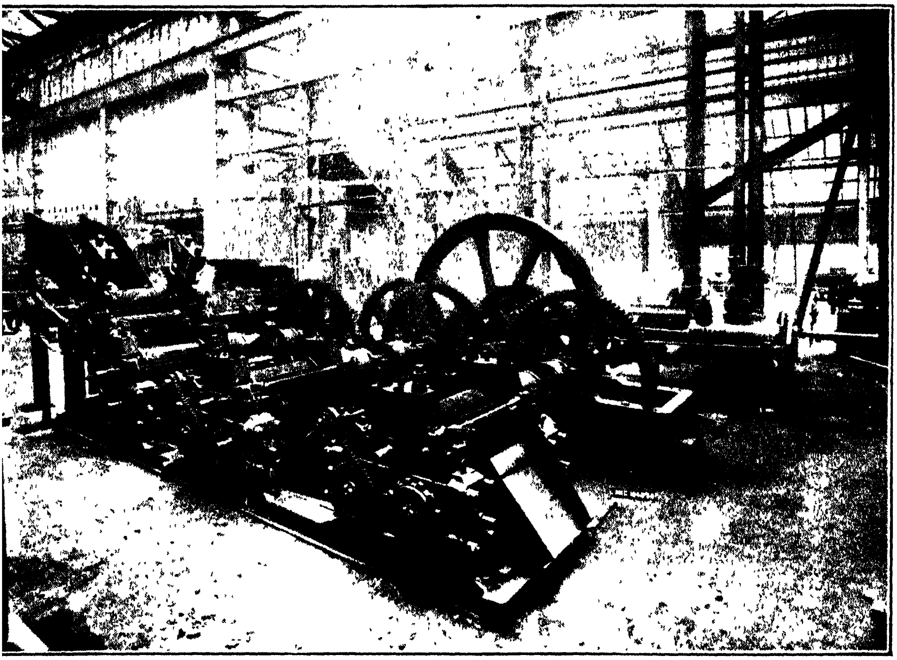

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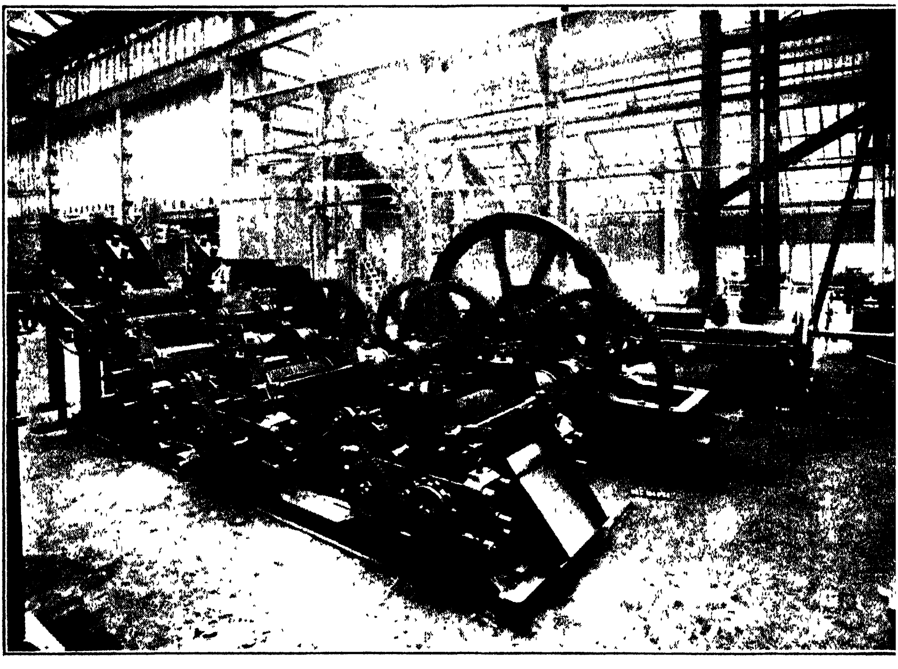

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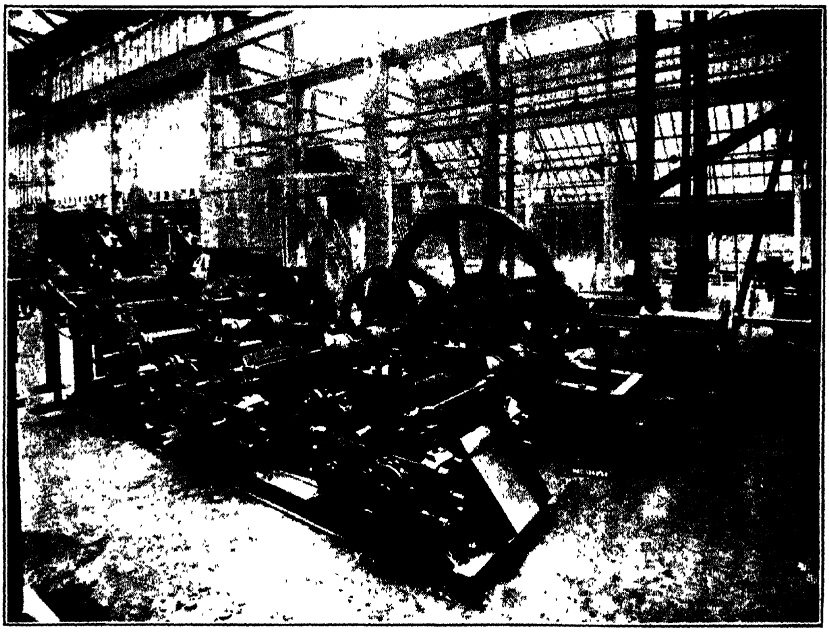

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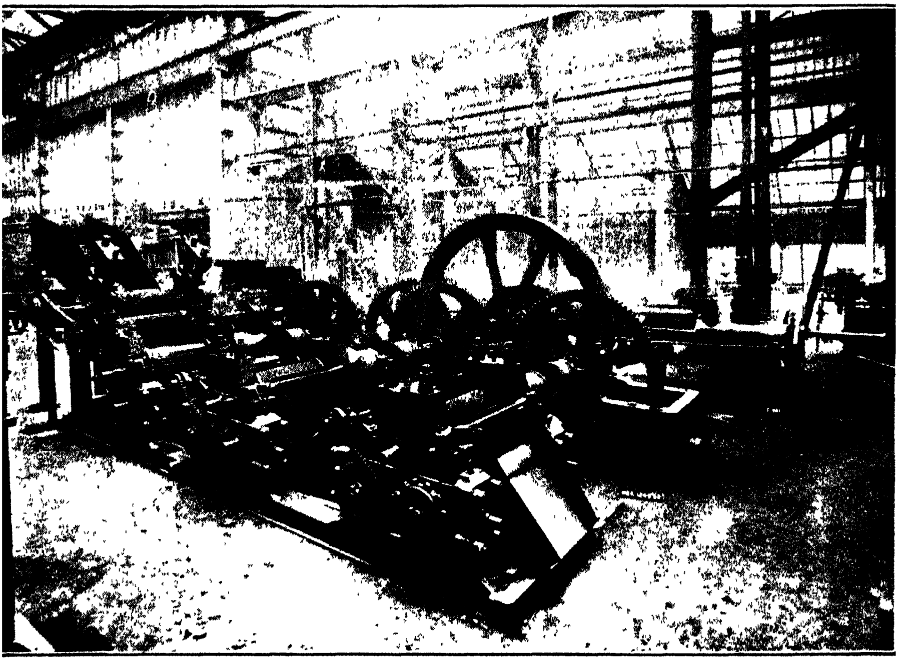

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☛ The Journal is published about the 15th of the Month.

ANNUAL SUBSCRIPTION,
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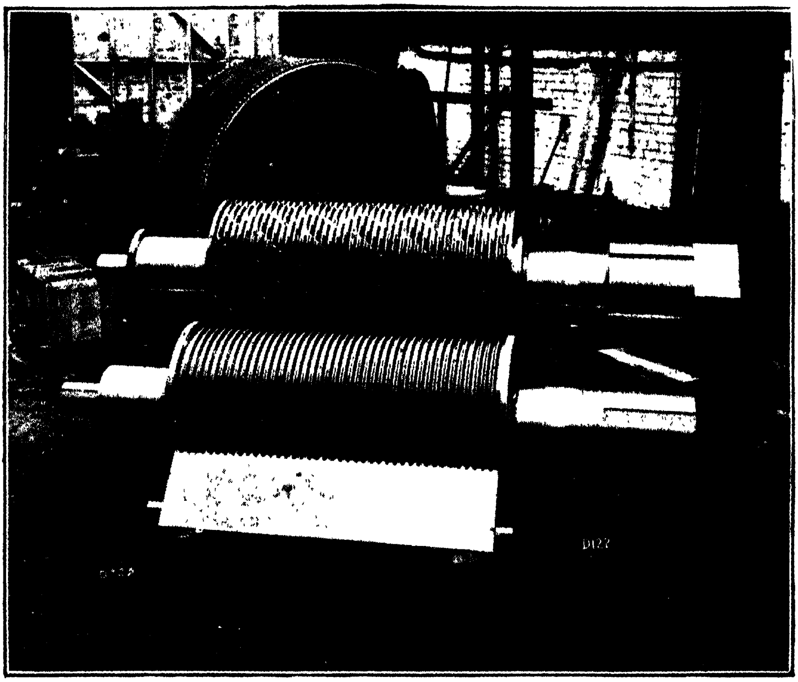

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INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 301. JANUARY, 1924. VOL. XXVI.

Notes and Comments.

The Political Outlook at Home.

A month ago politics at home were in a state of turmoil, as the result of a general election in which three parties sought the suffrage of the electors and no one of them got a clear majority over the other two. The Government had sacrificed a clear majority in the old House of Commons in an honest attempt to secure support for tariff reform as a means to alleviate unemployment, but they were greatly disappointed in the degree of support their new proposals received. Apart from the point that the election was too hurried to give the new policy a chance, it was evident from an analysis of the results of the polls, that there is a large section of the electorate (including office workers and persons with fixed incomes) who were afraid that any taxation of imports would raise the cost of living to them without giving them any corresponding advantages. Hence the large measure of support the Liberals received. Parliament meets just when this issue of our journal appears, and we shall soon know whether the forecasts of the holidays are borne out—that the Liberals and Labour will combine to throw out the Conservative Government and then that Labour, as the next largest party, will have first choice of office. If they accept it, they will be in a similar quandary of being a minority in the whole House and be liable to defeat by the other two parties if any contentious legislation is attempted. It is an unfortunate stalemate, but if Labour is ever to govern, it is just as well that it should make the first attempt under the control of a strong Opposition.

British Beet Ventures.

Reference has already been made in our pages to plans for the establishment of another beet sugar factory in this country—in Suffolk. Further details are now available, from which it appears that a syndicate has been formed under the title of the East Suffolk Development Syndicate, Ltd., and is about to erect a beet factory at Southwold Harbour in time for next season. The harbour has been acquired for the purposes of the factory, and a circular railway, 45 miles in length and serving an area of 200,000 acres, is in contemplation for the transport of the roots. The factory is to be owned and controlled entirely by Englishmen. The chairman of the scheme is, we gather, Mr. F. H. KEEBLE PEARSON (a member of the famous firm of contractors of which LORD COWDRAY is the head), while LORD HUNTINGFIELD, M.P., and Mr. GEORGE DE BELLE BALL are also actively interested in the venture. The new factory is expected at the start to produce 8000 tons of sugar per season, but will undoubtedly be capable of further expansion should sufficient support from surrounding growers be forthcoming. At a meeting arranged to interest these latter, it was stated that beet farmers had lately made profits of £10 or £12 per acre.

The latest news of the Kidderminster scheme is that it is held up for the time being for lack of capital support. Undoubtedly the result of the general election has had an adverse influence on offers of financial assistance, and until the political horizon is clearer and it is known with more certainty what attitude the other political parties aspiring to government will adopt towards the present preference on home-grown sugar, the money will hardly be forthcoming.

Another project which is taking shape is in Notts, where a Company is proposing to erect a beet factory at Colwick. At a local meeting of the National Farmers' Union, held at Nottingham a fortnight ago, Major T. S. IMPEY, on behalf of the projected Company, stated that at the moment the names of the directorate could not be revealed, but they were prominent in the shipping trade in Glasgow, and Sir ERNEST JARDINE, of Nottingham, would take a leading part. The factory though practically certain is not quite settled in its details, since as a preliminary step it is necessary to obtain contracts for 5000 acres of roots this year. Next season 10,000 acres would be required. Four big shipowners have agreed to find the capital for this company, and it will be run entirely with British capital and on British lines. It is hoped to complete the factory for the 1924 campaign next October.

Finally, sustained negotiations are in progress to establish a factory in Gloucestershire, and the local Chamber of Agriculture and the Farmers' Union are taking steps jointly to ascertain what acreage of roots is likely to be obtainable.

British Beet Sugar Machinery.

Apropos of these projected factories which, we are told, are to be erected with English capital and run on British lines, we have not heard that it is proposed to equip any one of them completely with machinery made in this country. We hope the precedent of Cantley and Kelham is not to be followed *sine die*. We ask this question because we notice a recent letter which appeared in the *Engineer* from the British Empire Sugar Machinery Manufacturers' Association. In it the Secretary stated that "to those familiar with the initiation of the Cantley and Kelham beet factories, it is well known that the former was promoted by a number of Dutchmen who had at their disposition a considerable quantity of used beet sugar machinery, and it was part of their policy that it should be offered to the proposed Company and installed at Cantley. This was accomplished, and that machinery has been supplemented from time to time by Germany machinery. With regard to Kelham factory, the promoters placed themselves unreservedly in the hands of a French firm for the supply of machinery and the arrangement of the factory.

"British machinery manufacturers were never invited to tender for the supply of machinery to Cantley, or Kelham, or Kidderminster. Had they been allowed to do so, a thoroughly sound scheme would have been put forward, which would have shown that the sugar machinery manufacturers of this country can produce a plant which is at least equal to that produced on the Continent."[1]

Production Costs in United States and Cuba.

The United States Tariff Commission issued on December 1st a preliminary statement of the data relating to the cost of production collected by the Commission in the investigation which it has been carrying on under the authority conferred by the Tariff Act of 1922. The statement consists in the main of a series of tables containing averages of cost figures gathered by the investigators who have been working for the past several months in the various sugar producing sections of the United States and in Cuba.[2]

The investigation was undertaken as the result of an application filed shortly after the present tariff law went into effect by representatives of interests engaged in sugar production in Cuba. A public hearing is to be held on this application on January 15th and the purpose of the Commission in issuing a preliminary statement of costs is to supply those interested in this hearing with the general results of the Commission's inquiry as a basis for such arguments and supplementary or explanatory statements as they may care to submit.

The figures contained in the statement related to the 1920-21 and 1921-22 crops of Hawaii, Porto Rico and Cuba, and to the 1921-22 and 1922-23 crops of Louisiana and the Beet region. They are nearer actual average costs than has been the case in previous Government investigations, inasmuch as the figures are taken from a much higher percentage of the existing mills, than was the case in 1916-20 when the last investigation was instituted.

The cost figures for 1921 and 1922 in cents per lb. of sugar produced, being the net cost, f.o.b. mill with interest, are as follows:—

	CUBA.	HAWAII	P.R.	LOUISIANA.	DOMESTIC BEET.
1920-21	3·9755	4·3389	4·8725	3·9681	5·0271
1921-22	2·1464	4·0135	4·0494	4·8565	5·5894

With regard to these figures it is pointed out by our contemporary that to compare the beet with the raw sugar the average cost of refining (given by the Commission as 1·0087 cents per lb.) should be deducted from the figures for Beet. The 1920-21 crops were affected by the high costs of the year 1920, especially in Cuba, while the crops of the 1921-22 season were everywhere produced on a lower and more normal cost basis.

Since the principal purpose of the Commission's investigation is to determine whether the import duty charged against Cuban sugar brought into the United States is greater or less than the difference in cost of production, it is interesting to note from these figures that whereas the tariff on Cuban raws is 1·7648 cents per lb., the cost of production in every branch of the domestic industry is higher than the cost in Cuba plus the tariff by from 0·10 to 2·49 cents per lb. The results of the enquiry on the 15th of this month will hence be awaited with some interest.

Recent Company Reports.

The last few months of the year bring in a crop of sugar company reports, especially of companies whose headquarters are in London, though their sphere of operations is in the tropics. We give the gist of several of them below.

---

[1] It is stated that Cantley has during the past 12 months spent £30,000 with British engineering firms. This is all to the good but it is not the price of a complete factory and we fear it is the case that foreign machinery will figure largely in pending contracts.

[2] We quote from *Facts about Sugar.*

The East India Distilleries and Sugar Factories, Ltd., recorded an improved year at their annual meeting in December. Trading profits were £17,000 in excess of 1922, being £100,000 as compared with £42,000 in 1913. Goodwill in the pre-war year stood at £100,000 but is now reduced to £65,000, while the reserve fund which in 1913 was only £15,000 now stands at £105,000. A dividend of 10 per cent. on the ordinary share capital was passed.

The third ordinary meeting of the Sena Sugar Estates, Ltd., held last month under the presidency of Mr. A. N. LUBBOCK, reported a very short crop owing to drought; but the output in 1922, which was nearly 24,000 tons, resulted in a profit of £35,125, thanks to the good price sugar fetched. The 1923 crop which was just finished amounted to 33,000 tons. The directors believed that in a normal season they could turn out sugar as cheaply as any other part of the world. If the 1924 season was normal, they expected an output of 43,000 tons including the first small crop from their new Luabo factory. The dividend declared for the year was 2½ per cent.

At home Messrs. TATE & LYLE, LTD., the sugar refiners, have at length been able to present three years' accounts to September 30th last, the delay being due to difficulties with the Inland Revenue authorities. In the period covered net profits amount to £2,259,462 or at the rate of £753,154 per annum. Out of this a reserve fund of £500,000 has been created, leaving, with the balance brought in, a divisible surplus of £1,759,462. Sir ERNEST W. TATE in presenting the accounts at the annual meeting stated that the considerable profits were due not only to sugar refining in itself, but also to the fact that, being compelled to hold immense stocks of raw sugar, they had benefited by a rising market which had enabled them to re-sell the sugar at a larger profit than usual. For the past year the Tate & Lyle ordinary shareholders get 15 per cent. free of tax.

Trinidad Vicissitudes.

At the last meeting of the St. Madeleine Sugar Co., Ltd., the Chairman, Mr. MOODY STUART, gave an illuminating account of the vicissitudes of the sugar industry in Trinidad under the influence of meteorological or economic changes. Half-a-dozen years ago this island produced 70,000 tons of sugar, while last year it was but 41,000 tons—a difference of 41 per cent., or put in money, £750,000 between the best and worst in recent times. Since St. Madeleine provides one-third of the total island crop, the difference to the company amounts, on the above premises, to £250,000. Taking averages, the crop of Trinidad since 1914 has averaged 57,000 tons. This year is 30 per cent. below that, or, in money value, £400,000, of which St. Madeleine's share is £130,000.

The shortage has been due partly to economic and partly to adverse weather conditions. In 1920 there were labour difficulties; they could not get the land tilled because of the boom in oil and the boom in cane-farming. In 1921 the weather was unfavourable; they could not get the land tilled, because almost continuous rain kept it sodden for the last six months of the year. These adversities fell with full weight on the 1923 cane crop and reduced it to a point only twice reached by the island in the past quarter of a century.

But much progress has now been made towards restoration of the estates. Lately the weather has been very favourable for working the land, and labourers have been very plentiful and have worked well. This comes too late, it is true, to affect fully the 1924 crop, though the latter may with luck attain the average of the past five years. But any decided results will come first in 1925; it is anticipated that the crop of that year will, bar accidents, exceed any previous crop save the phenomenal one of 1917, when over 70,000 tons of sugar was obtained.

Notes and Comments.

A New Zambesi Sugar Factory.

Reference was made at the annual meeting of the Sena Estates to a new estate and factory of this company on the Zambesi, which is being named Luabo. This new factory is situated 17 miles nearer the coast than Marromeu and on the opposite bank of the river and therefore within Portuguese territory. The building is more than half completed and expects to be ready for crushing in July, 1924. We understand the machinery is being supplied by the Mirrlees Watson Company, Ltd., of Glasgow. The original estimate of the cost of the factory and surroundings was £300,000, but it is likely to turn out much nearer £400,000. The estate was started on a wild barren plain, where not only the factory but the usual town for housing the staff has had to be erected. During 1923 the plantation of cane was increased to 4000 acres, and the full capacity of the new factory should be reached with the 1926 crop. This company also intend to link up Caia and Marromeu factories, 57 miles apart, by means of an extension of their railway lines, so that cane grown at Marromeu can be sent by rail to be crushed at Caia, and *vice versa*.

Growth of Sugar Production in Italy.

With the ever-increasing consumption of sugar in Italy, which has risen from 6 lb. per head per annum in 1900 to 11 lb. in 1911 and to 17·2 lb. in recent years, the importance of the sugar beet crop and of the output of Italian refineries is growing steadily, according to the Association of Italian Corporations.[1] From 1884 to 1895 an area of less than 2400 acres was planted to sugar beets, in 1911 it rose to 112,000 acres, and in 1913 to 164,000 acres. During the war years the acreage under this crop declined rapidly, but in 1921 the pre-war figure was almost attained, and this year it rose to 223,200 acres.

The sugar industry now represents an investment of 400 million lire, and is carried on in 40 sugar mills and 12 refineries belonging to 24 companies scattered over the peninsula. The sugar mills are equipped to deal with 40,000 metric tons of beet per day, and the daily output of the refineries is estimated at 200 metric tons of sugar. The machinery and equipment of the plants are up-to-date. Over 5000 workers are employed in the industry. The following figures show the Italian output of refined sugar for the past few years :—1910–11, 169,250 metric tons; 1913–14, 296,946 metric tons; 1917-18, 92,624 metric tons; 1922-23, 264,250 metric tons.

The latest estimates published by the Sugar Union place this year's crop at between 2·7 and 2·8 million tons of sugar beets, with a much higher sugar content than of recent years, and it is expected that the output of the factories and refineries will exceed 300,000 tons, thus breaking the record of 1913, the highest yet obtained in Italy. It is confidently believed that the yield will suffice to cover the needs of the home market. Several other sugar mills are being built, and the prospects are that in a few years' time the output will leave a margin for export. At the same time the manufacture of jams and preserves, a considerable quantity of which are exported, is becoming an important industry, the prosperity of which is intimately connected with that of the sugar refineries.

The price of sugar is very high in Italy, where it retails at 6·40 lire per kilo., and more for the finer qualities of lump sugar. This is mainly due to the very heavy Excise duty of 300 lire per quintal levied by the Government. The Customs duty on imported sugar is 21·60 gold lire per quintal.

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[1] As translated in the *Board of Trade Journal.*

Fifty Years Ago.

From the "Sugar Cane," January, 1874.

Mr. THOMAS G. THRUM contributed an article entitled "Notes on the History of the Sugar Industry of the Hawaiian Islands," in which he stated that actually the earliest record of sugar having been made there dated back to 1802, the manufacturer being "a Chinaman on the Island of Lanai, who arrived in one of the vessels trading for sandalwood, bringing with him a stone mill and boilers, and after grinding off one small crop and making it into sugar went off the next year with his apparatus . . . . . . Sugar was made in Honolulu about 1823 by LAVINIA, an Italian, who had the cane pounded on huge wooden trays (poi boards) by natives with stone-beaters, collecting the juice and boiling it in small copper kettles." But it is to a firm called LADD & Co. that credit is to be given "for the *bona fide* establishment of sugar manufacture, who in 1835 secured a grant of land at Koloa, Kauai, from the Government for silk and sugar culture. This seems to have been the first systematic sugar plantation, and was under the charge of a Mr. HOOPER, who broke up the land with a light plough drawn by natives. Their first mill must have been a rude island-made one, doubtless, as mention is made of an iron one having arrived in 1837."

P. CASAMAJOR, of New York, wrote on the "Testing of Sugar Solutions by Means of Areometers and the Optical Saccharometer," his paper dealing largely with "Ventzke's process for obtaining the pure sugar in the dry substance of a solution, based on the fact that 26·048 grms. of pure sugar dissolved in water so as to occupy 100 cubic cms. at 17½°C. gives a solution of specific gravity 1·1." It was explained that "as it is no easy matter to obtain a solution of sugar of specific gravity 1·1 at 17½° C., Ventzke has made a table by means of which the specific gravities at other temperatures are given. For instance, the solution which at 17½° C. has a specific gravity of 1·1; at 14° C. has one of 1·1008; at 9° C. one of 1·1018; and at 30° C. one of 1·0964."

Another chemical contribution was by H. LANDOLT, who discussed methods for the determination of sucrose in raw sugars and syrups, working presumably with beet products. This writer gave preference to the method depending on the amounts of reducing sugars found before and after inversion, and gave figures showing that this "copper test" yielded results in the case of "syrups" averaging about 2·5 per cent. higher than those found by direct polarization. As to the Clerget double polarization method, he was of the opinion that this compared with direct polarization gave "less trustworthy results, since, by treatment of the salts with hydrochloric acid, organic acids are set free which turn the way of light partly left and partly right."

Lastly, in this issue of our predecessor, there was a review of the sugar market for the year 1873, in which attention was called to the fact that whereas "coal, iron, copper and most of the metal used in manufactures have throughout the year been almost at panic prices," and corn, cattle, potatoes, and most food stuffs had also become very dear, yet sugar alone was cheap, the consumption *per capita* having risen to 60 lbs. This was due in the main to the importation of bounty-fed sugar from the Continent, principally from France, leading the writer to remark that "should the contest continue much longer upon such unequal terms there will be serious danger of the foreigner obtaining the monopoly of the British market . . . . . . a catastrophe which could have as its results no other than the permament oppression of the English consumer and the spoliation of the French tax-payer, all for the aggrandisement of the French refiner . . . . . ."

The Australian Sugar Industry and its Prospects.

Working of the Pool.—Another Experiment.

By T. D. Chataway.

The Royal Commission of 1895 recommended that the Queensland example of relying upon central mills and tenant or independent farmers to supply the raw material, should be tried in the West Indies. In each case the difficulty was to secure gang labour—white or black—and work it profitably. The genuine central mill system has been fully justified, at least in Australia, and the only districts in which it has not been adopted are in those climatically least suited to cane growing. There, cane cultivation is gradually going back. In the more tropical districts, where the system finds its most complete expression, cultivation is being extended, and the faint-hearted amongst us are beginning to fear that Australia will soon produce more sugar than she can consume. It is said that the Commonwealth cannot export sugar, and this may possibly be true of sugar in its ordinary state, but in such forms as preserved milk, biscuits, canned fruits and jams very large quantities of sugar can be sent abroad. The present position, which arose out of the commandeering of the products of the industry for eight years, and the refusal of the refiners to revert to their old system of financing the raw sugar mills, really marks a new departure. I have mentioned on a previous occasion how the sugar pool came into existence, and it has now fully established itself, has fulfilled its obligation to sell raw sugar to the refiners at a price which enables the latter to sell direct to the distributors at a figure which in turn leaves a fair margin of profit with the retail price at 4½d. a lb. One small difficulty has arisen in Western Australia. There the port is Freemantle, and consequently the grocers of Perth, to which place from the port there has to be paid 11s. railage, refuse to sell under 5d. a lb. The Board controlling the sugar pool has been charged with breaking the undertaking that the price would be 4½d. at all capitals, but of course all the other State capitals are ports, and towns away from the ports are allowed to add transport charges. The personnel of the Board of Control was mentioned by me some four months ago, and the members, representing manufacturers, refiners, growers and the State Government work in harmony.

THE GOVERNMENT'S VOICE.

The Chairman of the Board is, perhaps not altogether advantageously, a government official—the manager of the several central mills which are under government control. The effect of this is at times to introduce a little political timidity into the Board's decisions. A public official must of necessity keep his eye upon the political effect which his action may draw down upon the Government which employs him. The Board is not incorporated, and therefore remains a body unknown to the law. If there is an agreement or a contract to be made, the Board approves it or otherwise, and finally submits it to the Premier of the State, who, without exception so far as the public knows, gives his formal approval, and puts the signature of the Government to the document. My information is that even the political leaders suffer at times from timidity, and it is only the strong business men on the Board, who turn a Nelsonian eye to political arguments and really control. The popular idea, encouraged by the press in southern Australia, is that the Board is only another instalment of socialistic enterprise by the Queensland Labour Government; the above remarks should therefore dispel any such supposition.

NEW BUSINESS METHODS.

There has been a wealth of detail for the Board to attend to, but fortunately it has, as its leading member, Mr. G. H. PRITCHARD, formerly a bank manager in Townsville, but the organizer, and since its inception the Secretary, of the Australian Sugar Producers' Association, a body which embraces 80 per cent. of the cane growers, all the sugar mills, and to a considerable extent the refiners. The United Cane Growers' Association, representing the very small growers, has also its member on the Board, while both manufacturers and refiners have their nominees in this managing body. In brief, the whole sugar industry is organized into one body for the purpose of marketing its sugar, amounting this year to something over 250,000 tons. One of the first steps taken was to largely eliminate the merchant, and create direct trading between the distributors and refiners. Thus the manufacturers were to receive £3 6s. 8d. less for their 94 per cent. sugar, but as compared with the recent prices the distributors will be better off by £4 8s. 8d. a ton of refined sugar. Hitherto the refiners did not sell direct to the retailers, now they will sell and deliver within the city boundaries of the capitals at a price—£37 11s. 4d. a ton—which will leave the retailers a margin of £5 8s. 8d. a ton. Grocers by a rule-of-thumb practice declare that 20 per cent. should be added to all goods, in order to cover overhead charges, and it is obvious that the above margin does not cover this requirement, but the grocers are quite silent on the subject, compared with their vociferous complaints a year or two ago. Arrangements have also been made to enable those merchants who distributed to country centres, and gave credit to storekeepers, to carry on. An important principle is involved in the announcement that rebates would be granted to those using sugar in manufactures for local consumption. The details have at present been withheld, and it may be hazarded that the rebates on home consumption have behind them considerable political significance. This means that they are likely to be more effective upon paper, than beneficial in reducing the cost of jam. Rebates on sugar used in exported goods will be more definite, and it is understood will vary from time to time as a competent authority declares what is the world's parity price of the sugar the manufacturers require.

THE GROWERS' GRIEVANCES.

The consumers having been made a present of £1,306,666, to quote the Secretary of the A.S.P.A. in a letter to the Queensland Premier, the growers and manufacturers are troubled because they must divide the loss of £3 6s. 8d. on an average crop of 280,000 tons, and next year the loss may be increased, but there seems no immediate chance of reducing two important items of expense. The Industrial Court will not reduce the cost of labour, which remains exceptionally high though the cost of living in Queensland is lower than in most of the other States. The shipping companies, having raised the cost of bringing raw sugar to the refineries by 150 per cent., flatly refuse to make any concessions in their rates. Doubtless these matters will adjust themselves before long, especially in the matter of shipping, into which a Royal Commission is now inquiring. Shipping companies, protected under the Navigation Act from foreign competition, complain that the Act imposes additional costs upon them. On the other hand if the protection is withdrawn, they declare that German and Japanese ships will capture the coastal trade. There is plenty of material for argument, and also many reasons why the ships along the coast should make it their business to put themselves into a position to bring costs of freighting raw sugar to the refiners within reason. In the course of a year the sugar freights total some £500,000, a by no means insignificant sum.

GOVERNMENT-CONTROLLED CENTRAL MILLS.

With commendable promptitude the general manager of the central mills, practically owned by the Government, has issued his report on their operations for the year ending June 30th last, and almost immediately it is followed by the report of the Auditor-General on the returns supplied. The period covered is practically that of the last six months of 1922, though in some cases crushing operations may not have been completed before early in this calendar year. In June last the *International Sugar Journal* published some comments by me on the figures at these mills for 1921, and I then remarked that those for 1922 would probably differ from them very slightly. In the following Table I give the returns for both years, in order that the failure to lower the cost of production may be clearly seen :—

	OUTPUT TONS.		COST PER TON. 94 PER CENT SUGAR.						PROFITS.	
	1921.	1922.	1921.			1922.			1921.	1922.
MILL.			£	s.	d.	£	s.	d.		£
Babinda	11,684	14,764	29	12	4	29	19	11	15,577	12,774
Gin Gin	3,457	3,298	28	9	1	29	14	1	8,461	3,921
Mossman[1]	8,000	8,144	30	5	8	30	4	1	5,108	8,144
Mount Bauple	2,897	2,542	29	8	6	31	15	0	3,833	-1,933
North Eton	5,907	3,871	29	10	9	30	12	10	5,907	145
Proserpine	7,575	4,765	29	0	4	30	10	9	11,639	326
South Johnstone	12,269	14,136	29	8	5	28	15	8	17,133	19,802

The general manager of these mills explains the Mount Bauple loss as being due to a short crop and inefficient working, but it must be remembered that £2065 has been charged up as interest on the original capital. In every case interest on capital is charged against the crop, and this of course means that the profits have been very much greater than shown. Possibly, it is a moot question as to whether the interest charge should appear amongst the production expenses, and at least one well-known industrialist—HENRY FORD—is distinctly of opinion that it should not be. Maintenance, repairs and depreciation are all charged, while the off-season costs for salaries and general expenses in nearly every case amount to well over £1 per ton of sugar produced. Thus in the case of Babinda off-season expenses totalled no less than £15,147, though Gin Gin escaped with only £2885. As I think I have remarked on a previous occasion these are the figures where the Government practically controls, and are open to the suspicion that red tape and at times political considerations stand in the way of the most economical management. Such mills as Babinda and South Johnstone, new and up to date, with a capacity of at least 15,000 tons were able last year to work well within that capacity, and at the same time pay interest on capital, and in the case of the former something towards redemption. The true position of these mills is best seen by the following :—

MILL	CAPITAL £	PROFITS. £	INTEREST. £	TOTAL NET EARNINGS PER CENT. CAPITAL.
Babinda	391,089	12,774	27,869	10
South Johnstone	547,525	19,802	19,077	7

The figures are instructive, showing as they do that there is no considerable margin of profit if these mills represent anything like the maximum in economical management. In the above small table the interest paid by Babinda included some redemption, while South Johnstone used its profits to redeem a portion of the loan capital. This alone helps to emphasize the fact that interest is really profit, and not an ordinary charge against working expenses.

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[1] This mill is not controlled by Government.

OTHER CENTRAL MILLS.

There are several central mills which have completely liquidated their liability for the original loans from the Government, while the Mossman, which is still nominally under the control of the Government, seeing that it owes a small amount payable in June next year, but which it could easily enough have paid out of last year's profits, is included in the statement already given. The seven mills are co-operative concerns, and have no particular interest in making the details of their operations public property. We know what they produce each year, what wages they must pay, and what their suppliers are awarded under the Cane Prices Board. We also know what they get for their sugar. In these various items they stand on the same footing exactly as the mills under the Control of the Government. There are also mills owned by private companies or individuals, and these again only differ from the Government-controlled mills in the quality of the management. There is reason to think that generally the farmers get paid a higher price for their cane by those mills which are not controlled. Throughout its history the Colonial Sugar Refining Company—owning half-a-dozen mills—has always, upon investigation, been found to pay rates considerably higher than any awards. Particulars are not easy to obtain, but I noted that last year the Mulgrave Central Mill paid 8s. 5d. a ton to its cane suppliers over and above the legal award. All the mills have been rapidly improving their plants, and increasing their efficiency and capacity, and the cane-growers are increasing in numbers. In the Tully district, where it is anticipated that a new mill, costing with all its extras about £750,000, and having a capacity of at least 15,000 tons, will be erected in time for the 1925 harvest; scores of farmers are already on the land busily planting, neighbouring mills having agreed to take their cane until their own mill is at work.

PRESENT HARVEST.

One anticipates some remarkable figures from the present harvesting season, when the results become known. Last January and February there were large areas which did not receive rain, and even in March the falls were far below the average. The prospect of a 300,000 ton crop, which was possible if the regular monsoons had treated the sugar districts according to experience, disappeared, and authorities began making estimates of half that amount. Rain fell in March, though not excessively, and the cane responded wonderfully in the central and southern districts, while further north what promised to be a fair crop was greatly strengthened. Since then there has been practically no rain, but the crops, the harvesting of which is now nearly completed, have proved most rich in obtainable sugar. Some such result of the dry winter was expected, but my information is that the final figures will border on the phenomenal. The latest estimate for Queensland and New South Wales, made by the Superintendent of Queensland Sugar Experiment Stations, after travelling right through the sugar districts, is an output of 255,000 tons, which is after all not a very great deal below expectations nine months ago.[1] A cane-grower on a considerable scale, who is also the chief public representative of the sugar industry, told me not so long ago that for weeks the cane in his district had been yielding sugar at the rate of three tons to the acre, while on all sides reports come to hand of the richness of the crops making good the deficiency in the weight of cane. There has been relatively little trouble with labour, and nothing approaching the difficulties which in 1922 held up the work at the Mourilyan waterside for so long, that the reconditioning of the stranded sugar involved a loss of several thousand pounds. The worst trouble has been the frequency of fires in the canefields, especially in the North, and so bad did the matter become that the management of the Mulgrave Central actually closed down the receipt of cane for ten days, in order that the mill could deal with the accumulations in the mill-yard, and the impeded work of the boiling stations of the factory. It might be possible to attribute many of the fires to the excessively hot and dry weather, but unfortunately investigation has disclosed the presence of half-burnt candle-ends in the cane, rags soaked in benzine, and other evidences of attempted incendiarism. As burning the cane is calculated to react upon the cutters themselves it may be presumed that in many cases the "fire-bug" is someone with a personal grievance against an individual grower.

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[1] Later figures to hand show that the total production of all sugars in Australia (Queensland, New South Wales and Maffra) is now estimated in round figures at 280,000 tons.—ED., *I.S.J.*

PROSPECTS FOR NEXT YEAR.

It seems almost superfluous to talk about the danger of the price of sugar being reduced next year, though the arrangement with the Federal Government, in consideration of the continuance of the embargo on the importation of coloured-grown sugar, is that the present basic price of raws, namely £27 a ton, shall be subject to review by a tribunal, which would probably consist of the present Board of Control of Australian sugar and a Commonwealth representative. At this moment of writing, the middle of November, practically no rain has fallen since last March. The severest drought within our knowledge has prevailed all along the tropical coast-line. Within the last few weeks some thunder-showers have fallen in isolated spots, and to the ordinary observer it would appear that the next crop must be a failure. However, it is not beyond the experience of the sugar districts to have practically the whole of the crops, except perhaps in the most southern districts, grown between December and the following June. The white cane growers in our tropics are not easily discouraged, or they would have gone out of the business long ago. Obviously no estimate can be made of next year's output for a few weeks yet, but it is known that largely increased areas, not only in Queensland but also on the northern rivers of New South Wales, have been planted, mention being made of an increase of 20,000 acres in one North Queensland district alone.

THE PESSIMIST'S ANTIDOTE.

There are of course some in Australia who still cling to the belief that we shall never be able to establish tropical industries carried on with white labour, and that, therefore, for the sake of cheapness, we should admit the products of coloured labour countries free or carrying a minimum duty, even if we do not admit the coloured races themselves. The jam manufacturers and fruit canners have for many months been pressing this demand, and they have looked to Java as the one country above all which can produce cheap sugar such as they desire. The arrival in Australia of the volume by Mr. R. A. QUINTUS, entitled "Cane Cultivation in Java," is already attracting attention both in Melbourne and Brisbane. The book is an inspiration for those who hold by White Australia, and a substantial encouragement of the belief that well paid white artisans with mechanical aids can do all that the coolies of Java can do with their primitive implements and methods, and with the necessary restrictions upon the continuous cropping of land with cane. For instance the work of weeding the canefields in Australia has been reduced to a minimum by the invention and use of special implements, which not only remove the weeds, but by the reciprocating action of steel teeth loosen the soil between the rows, thus doing what in Java requires many coolies with hoes and sharp pointed sticks to accomplish. In one respect only does Java field work cost far less than Australian, and that is in the process of harvesting, and it is here that at present we have no suitable mechanical appliance. Politically, the book is likely to be largely used in this country, and it will not be overlooked that the author himself, though a Java man, is by no means enamoured of the conditions which many in Australia believe to be ideal.

The Steam Consumption of Cane Sugar Factories.

By P. H. PARR.

The question of the total steam consumption in cane sugar factories is one of very great interest, and, under modern conditions of working, of vital practical and commercial importance. This article offers a few suggestions with reference to the estimation of the probable steam consumption in a given case, and the results of calculations on the lines indicated are usually quite close to the actual requirements in practice.

The principal fuel in a cane sugar factory is of course the bagasse: with canes of less than 13 per cent. fibre, the bagasse is usually insufficient to provide for the total steam requirements of the factory, so that extra fuel, usually wood, has to be used, and in these cases it is evident that the most economical use possible must be made of the steam, so that juice heaters supplied with steam from one of the vessels of the evaporator, tanks covered and lagged in order to reduce the radiation to a minimum, and so on, are necessary for the most economical results, and the extra cost of the machinery will be more than compensated for by the reduced cost of the extra fuel.

With canes of 14–16 per cent. fibre, the bagasse is, with modern conditions of working, sufficient to generate all of the steam required by the factory, and the imbibition and other factors affecting the steam consumption can usually be adjusted so as to obtain a practically exact balance between steam generation and consumption, without either the use of extra fuel or the annoyance of surplus bagasse.

With higher fibre canes there is usually more bagasse than can be burned under the boilers, and the disposal of it may become a serious problem. It *can* be used for making a coarse grade of paper, but the total surplus bagasse is seldom, if ever, of sufficient quantity to make the installation of the necessary machinery a paying proposition. In general, for ordinary sizes of factories, and where very high fibre canes have to be worked, it appears best to burn up the bagasse as far as possible: triple, or even double, effect evaporators may be installed instead of the usual quadruple, so as to absorb the steam; imbibition may with advantage be very heavy, and so on, the chief requirements being ample boiler and evaporator capacity.

The conditions of working in different factories are so varied that general calculations for steam consumption are quite impossible, and a rough estimation of the requirements in an assumed particular case appears to be the most useful method in which to present the subject. For the purposes of exposition, a simple case is all that is necessary, and we will consider a cane sugar factory crushing 40 tons of 12 per cent. fibre cane per hour in a 14-roller milling plant, with 24 per cent. imbibition on the cane; juice superheated to 240°F.; subsided; concentrated in a quadruple effect evaporator; and the syrup passed directly to the vacuum pans; single curing of three grades of sugar; boiler pressure, 100 lbs. per sq. in.

The Steam Consumption of Cane Sugar Factories.

Referring to the article by the present writer on "Milling Plant Performance Estimations," in this Journal for May and June, 1922, it is seen that, with normal juice at 18° Brix, the milling plant should give mixed juice of 15·1° Brix equal to 98·5 per cent. of the cane, or $40 \times 2240 \times 0{\cdot}985 = 88{,}200$ lbs. per hour (8300 galls.), with a solid content of $88{,}200 \times 0{\cdot}151 = 13{,}300$ lbs. Also, the steam generated by the bagasse should be $40 \times 1087 = 43{,}500$ lbs. per hour.

Before considering the heat required for heating and evaporation, it is convenient to calculate the heat available from 1 lb. of steam. Where direct steam is used in the house, we may assume that it is reduced to about 30 lbs. per sq. in., and we find (all the properties of steam used by the writer are taken from the steam tables by Marks and Davis) that 1 lb. of steam at 100 lbs. per sq. in., reduced to 30 lbs. per sq. in., and condensed, will give out 946 B.T.U., or, with 5 per cent. radiation allowance, a net amount of 890 B.T.U. Similarly, taking the pressure in the exhaust main as 6 lbs. per sq. in., the heat given out by 1 lb. of exhaust steam on condensing is 958 B.T.U., and again, allowing 5 per cent. radiation losses, the net amount will be 899 B.T.U. There is very little difference between the two values, and for present purposes it will be quite near enough to assume that, for heating or evaporating, 1 lb. of steam, whether direct or exhaust, will give out a net useful amount of heat equal to 895 B.T.U.

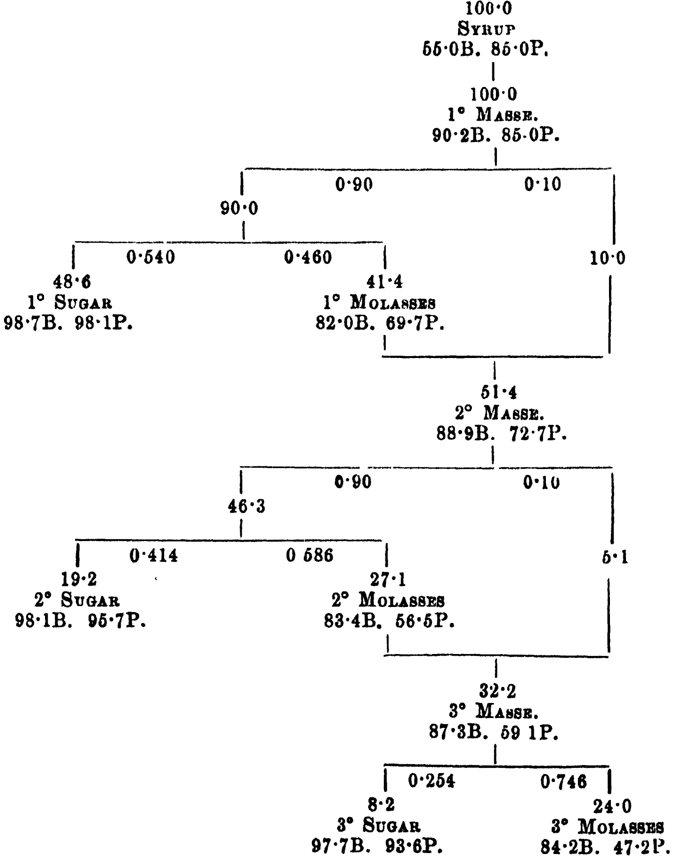
The specific heat of sugar liquors will be taken as $1 - 0{\cdot}0065 \times$ Brix, so that the specific heat of the mixed juice will be $1 - 0{\cdot}0065 \times 15{\cdot}1 = 0{\cdot}90$.

The juice will be heated by two heaters working in series, the first supplied with exhaust steam at 6 lbs. per sq. in., and the second by direct steam reduced to 30 lbs. per sq. in. From the writer's article on "Juice Heater Calculations" (*I.S.J.*, December, 1921), the first heater will raise the temperature of the juice from 80°F. to 180°F., and the second heater will do the remaining heating from 180°F. to 240°F. The first heater will require exhaust steam equal to $88{,}200 \times 0{\cdot}90 \times (180 - 80)/895 = 8860$ lbs. per hour, and the second heater will require direct steam equal to $88{,}200 \times 0{\cdot}90 \times (240 - 180)/895 = 5320$ lbs. per hour, or a total of 14,180 lbs. of steam per hour, which is 32·6 per cent. of the total steam generated by the bagasse, or practically one-third of all the steam available. These figures show very clearly that the raw juice heaters, as usually operated, are really the worst "steam-eaters" in the whole factory, a point which is not always appreciated at its full value. With high-fibre canes of 14 per cent. and over, the point is not usually of great importance, but with the lower-fibre canes, in order to secure ultimate economy in the working, it is absolutely necessary to maintain a fairly high pressure of 8–10 lbs. per sq. in. in the exhaust main, by connecting it across to the direct steam main through a reducing valve, so as to ensure that the first vessel of the evaporator shall work at about atmospheric pressure, when the first juice heater can be supplied by steam bled from it; this steam is then used substantially at "double effect," and the total steam requirements of the factory are appreciably reduced.

The next question is that of the evaporator, and we may assume that, whilst in the subsiders, the juice will have cooled down to about 180°F. Referring to the curves in the article by the writer on the "Theory of Multiple Evaporators," in the *Engineer* for February 18th, 1916, it will be seen that a quadruple effect evaporator, with juice supplied at 180°F., will evaporate 3·3 lbs. of water for each lb. of steam. Assuming a concentration in the evaporator of from 15·1 to 55·0° Brix, the evaporation must be 72·6 per cent. of the weight of the juice, or $88{,}200 \times 0{\cdot}726 = 64{,}000$ lbs. per hour, and the steam consumption of the evaporator will be $64{,}000/3{\cdot}3 = 19{,}400$ lbs. per hour, or 44·6 per cent. of the total steam generated by the bagasse. This amount, together with the 32·6 per cent. required by the juice heaters, already accounts for 77·2 per cent. of the total steam available without extra fuel, and the mere preliminary heating requires more than 70 per cent. as much steam as does the main evaporator.

The 88,200 lbs. of juice, after the evaporation of the 64,000 lbs. of water, leaves us with 24,200 lbs. of syrup at 55° Brix, still, of course, with the original 13,300 lbs. of solids in solution; it being understood that the figures given in this article are only rough values, for illustrative purposes, exact numerical equivalents to many figures not being necessary for the purposes in view.

The next question is that of the vacuum pans, and we will assume the simple (hypothetical) boiling scheme indicated below, where the quantities mentioned refer to the solids, B = Brix (solids), and P = purity (true), the purity of the syrup being assumed to be 85 per cent.



For the first boiling, assuming that the syrup has cooled to 100°F., and that the boiling temperature in the vacuum pan is 160°F., then we have 24,200 lbs. of syrup at 55·0° Brix. with a specific heat of $1 - 0{\cdot}0065 \times 55 = 0{\cdot}64$, to be heated from 100 to 160°F., requiring $24{,}200 \times 0{\cdot}64 \times (160 - 100)/895 = 100$ lbs. of steam for heating purposes. The Brix of the first massecuite being 90·2, the total amount will be 13,300/0·902 = 14,700 lbs., so that the evaporation must be 24,200 — 14,700 = 9500 lbs., and as the latent heat of evaporation at 26 in. vacuum is about 1020 B.T.U. per lb., the steam required for the evaporation will be 9500 × 1020/895 = 10,800 lbs., giving, with the 100 lbs. for heating, a total steam requirement of 10,900 lbs. per hour for the first boiling.

For the second boiling, the 10 per cent. of the first massecuite, or 1470 lbs., will be cut-over at pan temperature: the first molasses, containing 41·4 per cent. of the original solids, or 13,300 × 0·414 = 5500 lbs., may be taken as cooled down to 100°F., and diluted to 65° Brix, giving a total diluted molasses of 5500/0·65 = 8450 lbs., with a specific heat of 0·58, and to heat this to 160°F. will require 8450 × 0·58 × (160 – 100)/895 = 330 lbs. of steam. The molasses is, of course, "blown-up" in practice, but so far as steam requirements are concerned, it is substantially the same thing whether the heating is done in the molasses blow-ups or in the vacuum pan. The second massecuite contains 51·4 per cent. of the original solids, or 13,300 × 0·514 = 6850 lbs., and at a Brix of 88·9°, the total amount will be 6850/0·889 = 7700 lbs., so that the evaporation must be 1470 + 8450 — 7700 = 2220 lbs., requiring steam equal to 2220 × 1020/895 = 2530 lbs. per hour, or, with the heating steam, a total of 2860 lbs. per hour for the second boiling.

For the third boiling, the 10 per cent. of second massecuite, or 770 lbs., will be cut-over at pan temperature. The second molasses, containing 27·1 per cent. of the original solids, or 13,300 × 0·271 = 3600 lbs., may be taken as being cooled down to 100°F., and diluted to 80° Brix, giving a total diluted molasses of 4500 lbs., with a specific heat of 0·48; and to heat this to 160°F. will require 4500 × 0·48 × (160 — 100)/895 = 150 lbs. of steam. The third massecuite contains 32·2 per cent. of the original solids, or 4280 lbs., and at 87·3° Brix the total amount will be 4900 lbs., so that the evaporation must be 770 + 4500 — 4900 = 370 lbs., requiring 370 × 1020/895 = 420 lbs. of steam, or, with the 150 lbs. for heating, a total of 570 lbs. per hour for the third boiling.

The total steam requirements of the vacuum pans are thus: 10,900 + 2860 + 570 = 14,330 lbs. per hour, or 33·0 per cent. of that generated by the bagasse. As we have already, with the juice heaters and the evaporator, accounted for 77·2 per cent. of the bagasse, the addition of this amount makes 110·2 per cent., and it is at once evident that extra fuel will be required.

If we take scums, washings, etc., as 15 per cent. on the juice, heated from 100 to 210°F., the steam required will be 88,200 × 0·15 × (210 — 100) × 0·9/895 = 1460 lbs. per hour.

We may now tabulate the steam requirements for heating and evaporating as follows:—

	Lbs. per Hour.
Juice heaters	14,180
Evaporator	19,400
Vacuum pans	14,330
Scums, etc.	1,460
Total	49,370

or about 11 per cent. more than that generated by the combustion of the bagasse.

We now come to the power requirements. For the 14-roller milling plant, according to the article on "Milling Plant Performance Estimations," there will be required about 13 h.p. per ton of cane per hour, or a total of 520 h.p.; and if we assume the engines to be set at, say, 40 per cent. cut-off, and throttled down by the governor to the equivalent of 30 per cent. cut-off with open throttle, then we may expect, from the writer's article on the "Steam Consumption of Sugar

Factory Engines" (*I.S.J.*, November, 1923), a steam consumption of about 43 lbs per h.p.-hour, or a total of 23,360 lbs. per hour.

The barometric condensers for the evaporator and the vacuum pans will have to deal with about 28,090 lbs. of vapour per hour, requiring, say, 40 h.p. for the air pumps, which, at 43 lbs. per h.p. hour, means a steam consumption of 1720 lbs. per hour.

Taking the injection water at 36 times the vapours condensed, allowing a 30 ft. lift and a centrifugal pump with an efficiency of 70 per cent., there will be required 22 h.p., or, say, 880 lbs. of steam per hour for the direct-connected driving engine.

The crystallizers will require about 10 h.p., and the centrifugals with their accessories, say, 50 h.p., or a total of 60 h.p. at 43 lbs. of steam per h.p.-hour, giving 2580 lbs. of steam per hour.

For the electric lighting of the factory, 30 k.w., or, say, 40 h.p., working 12 hours out of the 24, or the equivalent of 20 h.p. continuously, is a reasonable allowance, which, at 38 lbs. per h.p.-hour, means 760 lbs. of steam per hour.

Now for the small pumps, about whose "steam-eating" capacities so much is often heard; for these pumps a fair pressure to use for estimating the b.h.p. required, in order to allow for the friction of the pump, etc., is $(p + 4)/0{\cdot}95$, where p is the total actual pressure, in lbs. per sq. in., against which the pump is working.

Imbibition water pump: 13,500 lbs. per hour against 50 ft. head. Net pressure, 22 lbs. per sq. in.; gross, 27 lbs. per sq. in.; b.h.p. = 0·4.

Return juice pump: the same, or 0·4 b.h.p.

Main juice pump: 88,200 lbs. per hour, at 200 ft. head (for the juice heater); b.h.p. = 9·8.

Scum pump: 13,200 lbs. per hour at 200 ft. head; b.h.p. = 1·5.

Evaporator drain pump, on the last two vessels: 32,000 lbs. per hour against a suction of 18 in. vacuum, or, say, 21 ft. head; b h.p. = 0·5.

Syrup extraction pump: 24,200 lbs. per hour, drawing from 26 in. vacuum, and delivering to the vacuum pan tanks 25 ft. higher. The 26 in. vacuum means 13 lbs. per sq. in., and with syrup at a specific gravity of 1·25, the 25 ft. lift means 13·6 lbs. per sq. in., a total of 26·6 lbs. per sq. in., and $(26{\cdot}6 + 4)/0{\cdot}95 = 32{\cdot}2$ lbs. per sq. in. gross, which means about 60 ft. head for the syrup, giving b.h.p. = 0·7.

Service water pump: say 0·5 b.h.p.

Boiler feed pump: for this we must make a rough estimate of the total quantity of feed water required, either from the above figures or by allowing 60-70 per cent. on the weight of the cane: taking 65 per cent. on the cane, the quantity will be 58,000 lbs. per hour, against a gross head of, say, 250 ft., requiring 7·3 b.h.p.

The total for the above pumps is 21·1 b.h.p., or, to be liberal, say 25 b.h.p., which, at 100 lbs. of steam per b.h.p.-hour, means a total steam consumption of 2500 lbs. per hour, or a little under 6 per cent. of the total generated by the bagasse.

We may now tabulate the steam requirements for power as follow:—

	LBS. PER HOUR.
Cane engines	22,360
Vacuum pumping engines	1,720
Injection water pump	880
Crystallizers, centrifugals, etc...	2,580
Electric lighting	760
Small pumps	2,500
Total	30,800

Allowing 10 per cent. of this to be condensed at the engines, there will be available 27,720 lbs. of exhaust steam per hour, as against the 49,370 lbs. required for heating and evaporating, so that there will be required 49,370 — 27,720 = 21,650 lbs. of direct steam per hour to the house.

The total steam demand from the boilers is evidently the sum of the steam required by the engines, and the extra requirements of the house, or 30,800 + 21,650 = 52,450 lbs. per hour. To cover radiation from the steam pipes, steaming in centrifugals, sugar dryer, etc., not allowed for in the above, we may add, say, 7 per cent., making a grand total of 56,000 lbs. per hour as the steam requirements of the complete factory. This is 62½ per cent. of the weight of the cane, which is quite normal for the conditions of working assumed as the basis of the above calculations.

At this point it is of interest to notice the percentage requirements of the various sections, and we have, noting that the actual consumption (condensation) of the engines and pumps is only about 10 per cent. of the steam passed through them :—

	LBS. PER HOUR.	PER CENT.
Juice heaters	14,180	25·3
Evaporator	19,400	34·6
Vacuum pans	14,330	25·6
Scums, etc.	1,460	2·6
General power	2,830	5·1
Small pumps	250	0·5
Sundries	3,550	6·3
	56,000	100·0

From the foregoing estimations it results that, since the factory requires 56,000 lbs. of steam per hour, whilst the combustion of the bagasse will only generate 43,500 lbs. per hour, 56,000 — 43,500 = 12,500 lbs. of steam per hour must be provided by the use of extra fuel. Assuming this extra fuel to be wood, as is most usual, with an evaporative power of 3½ lbs. of steam per lb. of wood, there will be required 12,500/3·5 = 3600 lbs. of wood per hour, or 4 per cent. on the cane, which is about normal for a factory working on the lines assumed above, with a quadruple effect evaporator. Many factories use 6–8 per cent. extra fuel, and some inefficient factories in Brazil use—or, at any rate, did use not many years ago—10–14 per cent. of wood.

It is of great interest, and of considerable practical value, to consider roughly the alterations in the conditions when the fibre percentage in the cane is higher. Referring again to the writer's article on "Milling Plant Performance Estimations" (*I.S.J.*, May and June, 1922), and the supplementary article (February, 1923), it will be seen that with a 14 per cent. fibre cane the mixed juice will be reduced in the ratio 94·2/98·5 = 0·955 : the steam requirements of the factory will be reduced roughly in the same ratio, so that 56,000 × 0·955 = 53,500 lbs. of steam per hour will be required in this case, whilst the bagasse will be sufficient to generate 40 × 1285 = 51,500 lbs. per hour, which is almost sufficient to satisfy all of the requirements.

With 16 per cent. fibre in the cane, the steam requirements will be reduced to approximately 56,000 × 90·0/98·5 = 51,000 lbs. per hour, whilst the generation from the bagasse could be 40 × 1477 = 59,000 lbs. per hour, so that there will be a surplus of about 15 per cent., which means 2 tons of surplus bagasse per hour, or, roughly, 7000 tons in a campaign of 150 days.

In general, where canes of less than 13 per cent. fibre are worked, it is most important to install every possible means of conserving steam in the house, to keep the imbibition water down and to use high pressures on all of the mills, so as to obtain the maximum extraction possible without high dilution: regular and even feeding of cane to the mills is of extreme importance if the best results are to be obtained from the ultimate commercial point of view.

With canes of 14-16 per cent. fibre, which are really the best for modern conditions of working, there is usually no difficulty in arranging and working the plant so as to obtain maximum efficiency, without using extra fuel and also without much surplus bagasse. A cane with about 15 per cent. fibre, giving a juice of high density and purity, with a minimum of gums, is about ideal for modern conditions of working. Ample boiler and evaporator capacity is essential.

With canes of more than 16 per cent. fibre, there is no use at all in trying to conserve steam in the house, and a triple, or even a double, effect evaporator is all that is required, but it must be able to deal with very dilute juice if the best results are to be obtained.

This article only touches the fringe of a question of great practical and commercial importance: the various methods of working, etc., are innumerable, but the writer believes that the figures offered are substantially correct and in general accordance with the conditions obtaining in modern cane sugar factories of ordinary size. Variations in the methods of boiling and curing make an appreciable difference to the steam requirements, but the main points are at present, and appear likely to remain, those of the imbibition, the raw juice heaters, and the evaporators.

Researches on the Sereh Disease in Java.

One of the main features of the present day pathology of the sugar cane fields is the baffling nature of some of the most widely spread diseases. This is somewhat difficult to account for; we have no reason to suppose that such diseases are more prevalent now than formerly. It may be partly due to the advanced state of our knowledge on the subject, in that the demands made nowadays for proofs in their etiology are so much more exacting than formerly. The wider outlook of the experts also includes so many possible contributory factors that their decisions are of a more tentative nature; and frequently a sugar cane disease which has been hitherto regarded as well known and to be found in a number of cane growing countries has shown such divergences in the hands of experimentalists, that we are led to the idea of local variations if not fundamentally different forms (as in gumming). We are thus in danger of losing the comfortable precision of diagnosis which is so desirable for the formulation of preventive measures.

It must be remembered also that those diseases which are, in their nature, easy to diagnose often receive comparatively little attention, while the best work is being put in where special difficulties are met with, and thus the discussion of the latter fills the pages of scientific journals. The more accurate work of these days is devoted to the study of ailments which have, from the first, led to no decisive result, and the forefront of the stage is occupied by such forms as mosaic, root disease, sereh, where no definite causative organism has as yet met with general acceptance. Of these the sereh disease in the Java cane fields is perhaps the outstanding example, and we propose to deal with it more particularly in the present paper.

It is natural that, with the great advances that have been made in recent years in bacteriological technique, diseases caused by bacteria are receiving special attention; most diseases which have not proved to be assignable to the presence of the more easily detected organisms have been now subjected to an intensive analysis by bacteriologists. And, just as in the days when modern bacteriology was in its infancy, various authors have not hesitated to speak of a "probable bacterial disease" as the most dignified way of confessing failure to locate the cause, so to-day, when bacteria are not found, we not infrequently meet with the suggestion of microbacteria, or such as cannot be detected by our most powerful microscopes. And the suggestion has this to be said for it that, while the study has failed in establishing a definite causative organism, the course pursued by the disease is exactly that which would be followed if bacteria or fungi were present. But a rival theory, that of "viruses" appears to have obtained a much wider support, in that the apparently normal sap of plants affected by disease has the power, it is true in very varying degree, of transmitting it to perfectly healthy plants on injection artificially or by transmitting insects or by the process of grafting. It will thus be seen than an entirely new phase of plant pathology has been entered upon, and there is little wonder that the main efforts of workers in this field are concentrated on these mysteries.

Impressed by the fact that the last attempt to locate a specific organism in plants attacked by sereh was as long ago as 1898, WOLZOGEN KÜHR[1] has recently submitted both perfectly healthy canes and those attacked by this disease to an extended bacteriological examination. And, as in one of his prefatory chapters to the paper containing his results, he summarizes the work of previous investigators on this disease, and also since this summary illustrates in a condensed form the rapid change in the point of view of plant pathologists during the last quarter of a century, the main facts of this history are here recorded. The symptoms of sereh, as given by WENT, are a little difficult to summarize, in that the external appearances vary a good deal according to the hold that the disease has upon the plant attacked. Usually, in the first instance, there is merely a shortening of the nodes towards the top of the plant, such as would occur in any period of stress when growth is interfered with. At a later stage, perhaps in the next generation, for the disease is transmitted by cuttings, not only are the leaves at the top much closer together and thus assume the form of a fan, but there is a general tendency for the lateral shoots to develop, accompanied by a similar protrusion of the root eyes. In a yet further state of the disease, the internodes are shortened all along the stem, and the whole plant is telescoped into a short space, masses of shoots grow out equalling the main stem in height and with prematurely expanded leaves of marked narrowness, while in the leaf sheaths masses of coiled roots are to be found on dissection. Meanwhile, inside the stem, the tissues appear to be more or less healthy, but there is the constant presence of a red coloration of the fibrovascular bundles, especially where the leaf joins the stem at the nodes, and this coloration of the bundles is accompanied by the presence of a gummy substance in the interior of the vessels. The whole field in the advanced stage of the disease bears a striking resemblance to one of lemon-grass, and sereh has thus acquired its name, which is the local term for this grass. Anyone accustomed to the inspection of cane fields in the tropics will have seen examples of such abnormal grass-like stools, and many of the seedlings produced, especially with north Indian parentage, have an altogether similar appearance permanently; and thus reports of the occurrence of sereh have been received from time to time from the most various countries. But as none of these cases has fallen in entirely with the detailed description given to sereh by the Javan experts, it is considered to be confined to the latter island.

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[1] Onderzoekingen Aangaande de Microflora, Aanwezig in normaal en sereh-ziek suikerriet. C. A. H. VON WOLZOGEN KÜHR. Archief voor de Suikerindustrie in Nederlandsch-Indië, Jaargang, 1923, No. 9.

The first record of scientific work on sereh is a paper by TREUB in 1885. He found that the roots were attacked by an eelworm, *Heterodera radicicola*, and therefore regarded it as the cause of the disease. Afterwards he met with a fungus of the genus Pythium also attacking the roots, and noted that when this was present the disease caused by the eelworms was intensified. SOLTWEDEL in 1889 confirmed the presence of eelworms in the roots of sereh plants, but the form he met with was different, namely *Tylenchus sacchari*. Nearly every year since the last paper appeared one or two have been published on the disease until 1911.

KRÜGER in 1890 was the first to associate bacteria with the disease, but this appears to have been merely a hypothesis, since he did not isolate any of these micro-organisms. JANSE in 1891 corrected this error and obtained a form in his cultures which was named *Bacterium sacchari* while in other cases he obtained *Bacterium glagae* in its place. As however he found the first named in healthy plants as well, he could not consider it as specific for the disease. He first of all sterilised the surface of the canes with 0·1 per cent. solution of corrosive sublimate and then boiled portions of the internal tissues for ten to thirty minutes in pure rain water, thus excluding all bacteria which were enabled to pass through this treatment by the possession of resistant spores. Since the spore-forming bacteria have not been found usually to attack plants, he thus excluded most of these which might be responsible for the disease.

Janse's experiments were repeated by various other workers. Thus DEBRAY found that his method did not completely sterilize the surface, and that if this was done bacteria were found in very few cases. VALETON in 1891 in repeating the experiments added a very complete study of the tissues of the affected plants, with the result that he was the first to discover that gum is always present in the reddened vessels. He also went a step farther in that, failing to obtain the bacteria by Janse's method, he pressed out the sap from the tissues and in this he found bundles of extremely fine rods which he considered might be the bacteria which JANSE had observed.

WENT in 1893-1896 devoted a great deal of attention to sereh. He described the disease carefully and considered, as the result of his studies, that it was not impossible that it was associated with a fungus, *Hypocraea sacchari*. But the chief interest of Went's work lay in the arguments by which he sought to establish its infectious nature. While parts of infected plants, when used for reproduction, always handed on the disease in an intensified form, perfectly sound plants introduced into an affected area showed a gradual infection according to the stages mentioned above, this cumulative character being one of the most striking features of the disease. He found such great variations in the infection of different varieties and even in different individuals of the same variety, that he paid special attention to the agricultural and other conditions under which they were grown, and he showed that these were of such importance that the question arose as to whether there was really any necessity for the presence of a parasite at all. WAKKER in 1897 rested on this view of the matter, and left parasites out of consideration altogether. He regarded the disease as arising from a lack of water which was accentuated by the stopping up of the vessels by the gum formed in them. He concluded that the spread of the disease was owing entirely to the use of infected material for planting.

Raciborski in 1898, having failed to find a causal organism, regarded the disease as, in the first instance, due to external conditions, but left room for the possibility of its being caused by a parasite. He made some remarkable tests with various tannin solutions, and in one case was able to induce all the symptoms of sereh in a few days with such a solution. He naturally concluded that no micro-organisms were necessary to bring about the disease.

Van der Stok in 1907 suggested that sereh-infected sugar canes arise by "double-race-variation" (dubbelrasvarieteit) from a normal plant. In such a case the production of healthy and diseased plants respectively would largely depend on external conditions; and, as in the case of other abnormalities, especially favourable conditions would tend to bring the diseased condition to the front. Zeijlstra in 1911 adopted much the same point of view, but assumed that sugar cane is a double race (dubbelras) consisting of forms immune to and not immune to sereh; and that the appearance of each of these forms is due to secondary influences acting on the plant. It is well known that varieties of sugar cane are often quite healthy when grown in the hills, that is, in conditions comparatively unfavourable to growth, while when grown in the plains under better conditions they are easily attacked, and this accords with Van der Stok's hypothesis, but the latter does not explain how it is that, when greater care in cultivation and manuring is taken in plains cultivation, the incidence of sereh is less severe. On the other hand both of these facts may be in accordance with Zeijlstra's theorem.

Quanjer in 1916 pointed out the great similarity betwen sereh and phloem necrosis, and suggested that these diseases are to be compared with the pseudo-hereditary phenomenon seen in the leaf roll of the potato, brought about by the presence of a hypothetical virus.

Willbrink, lastly, in 1920 conducted experiments on the contagious nature of sereh. She had successfully transmitted the gumming disease by cutting up pieces of diseased and healthy cane tissue with the same implements, but on attempting to do the same with sereh the method failed entirely. The author repeated these experiment himself and obtained the same results. This behaviour he regards as difficult to explain, if we are to consider sereh as spread by parasitic organisms.

The conclusion arrived at by him from this summary is that none of the hypotheses formulated have thrown much light on the nature (wesen) of the disease. The majority of the workers appear to be of the opinion that it is of parasitic character, without having been able to bring forward any conclusive proof of this.

C. A. B.

During the fiscal year ending September 30th, 1923, the Cuba Cane Sugar Corporation ground 4,303,407 tons of cane, yielding 3,284,731 bags of sugar. Although the tonnage of cane was slightly greater than in the previous season, the output of sugar was 94,720 bags less, owing to the lower sucrose content and recovery. Thus the average sucrose content was 12·74 as compared with 13·75 per cent., and the average yield 11 against 11·80 per cent. As to the financial returns for the 1922-23 and 1921-22 seasons, these show the following contrasts: Receipts per lb. of sugar (including proceeds from molasses and other earnings), 4·754, and 2·276 cents; cost per lb. of production (including the cost of the cane), 3·575 and 1·945 cents; cost per lb. of sugar manufactured, 1·060 and 0·946 cents; and operating cost per lb. of sugar made, 1·179 and 0·331 cents. The operating profit for the year was $12,608,122, as compared with $3,599,400 in 1921-22; and the nett profit (after payment of taxes, interest, and miscellaneous expenses) was $9,336,276, which was added to the consolidated surplus account, now standing at $10,234,630.

The Case for the Carbonatation Process in the Manufacture of White Sugars.

With Particular Reference to South Africa.[1]

By FRANCIS MAXWELL, D.Sc., M.I.Mech.E., F.C.S.

THE COSTS OF THE INSTALLATION.

Having dealt in a previous article[2] with the costs of manufacture proper, we now propose to examine the other factor that conjointly makes up the total cost of production of sugar, namely, the capital expenditure entailed in acquiring and erecting the necessary installation.

The essential question that arises in regard to the advisability of adopting any process of manufacture is whether a return is given on the capital invested. The sum required for the conversion of a sulphitation factory into a carbonatation factory depends on a number of factors, such as: whether the existing factory lends itself economically to alteration; whether a greater or lesser part of the existing plants can be used in the new arrangement; whether an elaborate or curtailed installation is acquired; whether the daily capacity of the factory is large or small; and so forth.

Let us begin by giving a specification of the apparatus which are essentially required for the carbonatation process. For our purpose we shall take as an example a factory with a capacity of about 600 tons of cane per day, and base our specification on conditions obtaining in Natal.

Complete carbonatation plant for a Natal factory crushing 600 tons of cane per day :—

One lime kiln, capacity 1412 cub. ft.
One gas washer, 4 ft. dia. × 10 ft. high.
One gas recipient.
Piping from kiln to pump and to saturators.
One CO_2 gas pump, 12 in. × 28 in. × 24 in.
Five first carbonatation tanks, each 250 cub. ft. nett.
Two second ,, ,, ,, ,,
Staging and platform for saturation tanks.
One lime slaker.
Two lime-milk mixing tanks.
One reception tank.
One lime-milk pump, steam driven.
Six first filter-presses, each 516 sq. ft.
Three second ,, ,,
Nine steel-plate mud shoots for filter-presses.
Two steam-driven 3-throw filter-press pumps, one pump 6 in. × 4¾ in. × 7 in. and one pump 5 in. × 4 in. × 6 in.
Piping, valves, and cocks to couple up complete plant.
Complete sulphurous acid gas plant for SO_2 saturation in the carbonatation tanks, consisting of: air dryer, air compressor, air recipient, sulphur furnace, gas scrubber and cooler, and piping.
(Optional).—Five low-pressure filters for syrup filtration, each 300 sq. ft.

It must be borne in mind that the above specification represents a *complete* carbonatation installation; and is submitted to the reader as a matter of general interest.

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[1] This is the third and concluding paper of a series, of which the first two appeared in this Journal in 1923 (pages 572-578 and 624-627).

[2] *Ibid.*, 1923, 624-627.

If the carbonatation process is to be introduced into a sulphitation factory, it is evident that the above specification is redundant; for many parts as specified therein are already existing in the usual sulphitation factory, or could be adapted suitably for the purpose in view. These, it may be assumed, are as follows:—

Two-thirds of the total filter-presses required.
Two-thirds of the filter-press shoots.
One filter-press pump.
Entire sulphur gas plant.
About half of the lime-milk preparing plant.
A proportion of the piping and valves.

As regards the cost of a carbonatation plant, this will, of course, vary according to the special features included with the apparatus, some makers supplying a much more complete and useful plant than others while still covering the standard specification. For our purpose we shall base the price on a good average specification, including all the best features which may be desired in an up-to-date carbonatation installation. Following the complete specification minus the existing machinery as enumerated above, we find that the price of such a carbonatation plant, as supplied by a first-class British firm and delivered free at Durban, is about £12,000.

With regard to the capacities of the various apparatus, we have stated in a previous article[1] that by substituting De Haan's modification for the old process of double carbonatation an appreciable reduction may be effected in the capacity of the carbonatation plant. If this factor be taken into account, the capacities appearing in the above specification would allow of a certain reduction. But, on the other hand, it must be remembered that those figures are based on South African conditions; consequently, the gummy and refractory nature peculiar to Uba juices, the quality of the limestone used, etc., have to be considered. On the whole, therefore, the above figures may be taken to represent the average for Natal and Zululand.

To estimate the capital involved in the actual conversion of a sulphitation factory into a carbonatation factory is not such an easy matter. For instance, a factory which has been designed on modern lines and possibly with an eye on future extension or alteration may be altered readily and cheaply; while another factory, which is of an old design and which has suffered repeated extensions without a preconceived plan, may entail considerable expense. For our purpose we have therefore kept in view a certain type of factory in Natal. The remaining charges in connexion with the new installation consist of transport from ship to factory site and erection costs, which, on the above-mentioned items, would amount to about £2000. Cost of making new foundations and unforeseen contingencies would be easily covered by a further allowance of £1000.

Summarizing, we find that the total capital involved in converting an ordinary factory, having a capacity of about 600 tons of cane per day, from sulpho-defecation into double carbonatation, would amount to:—

	£
For the installation	12,000
Transport and erection	2,000
Foundations and unforeseen local contingencies	1,000
	£15,000

Taking the interest at 5 per cent. and the depreciation at 10 per cent., this capital represents an annual charge of a round sum of £2000. At a yearly output of 8000 tons of sugar this is equivalent to 5s. per ton of sugar.

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[1] *I.S.J.*, 1923, 624.

By adducing figures arrived at in a previous article[1] we are able to submit finally the difference of costs of producing sugar between the carbonatation and the sulphitation process. The following data apply to South African practice.

Costs of production per ton of sugar by carbonatation differing from sulphitation :—

	s.	d.
Extra cost of manufacture proper	3	8
Interest and depreciation	5	0
Total extra cost of manufacture	8	8
Value of additional sugar recovered by carbonatation	18	0
Total difference in cost of production to the advantage of carbonatation	9	4

We thus find that it costs actually 9s. 4d. less to make 1 ton of sugar by the carbonatation process than by the sulphitation process. If we, moreover, take into account that carbonatation sugar commands 25s.[2] more than the average sulphitation sugar, this would mean an additional net profit of £1 14s. 4d. per ton of carbonatation sugar. For a factory with an output of 8000 tons of sugar this represents an additional profit of £13,733 per annum. The initial outlay of capital for the conversion of the factory would, at this rate, be returned within two seasons.

We may summarize this argument as follows :—

In spite of the large initial outlay of capital required for the conversion of a sulphitation factory into a carbonatation factory, the manufacture of sugar, under the present conditions in South Africa, is considerably more profitable if carried out by carbonatation than by sulpho-defecation.

THE FUEL QUESTION.

In the carbonatation process the quantity of milk-of-lime used is about ten times that employed in the sulphitation process ; and, moreover, a greater amount of wash-water is required for the filter-presses in the former process. All the extra water thus added to the juice has to be evaporated again, and consequently increases the consumption of fuel.

Although it is evident that more fuel is required for carbonatation, this fact does not necessarily imply that the fuel bill is thereby affected. In Java, for instance, the opinion has been expressed[3] that in carefully designed and well-balanced carbonatation factories there should be no reason for any necessity of supplementing bagasse with purchased fuel. This is rendered possible largely by the practice universally in vogue on that island of maintaining the factories in more or less continuous operation throughout the crushing season. In Natal and Zululand, on the other hand, it is customary to stop milling during the week-ends. It is clear that this *modus operandi* generally necessitates the use of extra fuel for starting up the factory, which necessarily would be more pronounced in carbonatation factories.

Inasmuch as the fibre content of the cane crushed has an important bearing on the quantity as well as quality of the bagasse as fuel, it is necessary to remember that while the cane in Java averages between 12–13 per cent. of fibre, the Uba cane in South Africa ranges from 15–18·5 per cent. This excessive amount of fibre in the latter cane should, to some extent, alleviate the necessity of burning extra fuel.

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[1] *I.S.J.*, 1923, 627. [2] *Archief*, 1911, 1359 ; *ibid.*, 1914, 1088. [3] *I.S.J.*, 1923, 626.

Although no special mention has been made in the foregoing calculations, the above circumstances have been fully taken into account in the margin of safety used.

GENERAL SUMMARY.

We have now completed the discussion of the subjects under the various headings set forth elsewhere, and we propose to conclude the treatise with a general summary of our series of articles.

It may be convenient to the reader if we here recapitulate the several conclusions reached in previous chapters in regard to the comparison of the carbonatation and the sulphitation process. They are as follows :—

1. From the point of view of coping with gummy juices, the carbonatation process is superior to the sulphitation process, for in addition to a more thorough clarification it ensures the rapid and uninterrupted run of all the manipulations which are the essential requirements in the manufacture of white sugar.

2. A higher yield of sugar is obtained by the carbonatation process than by the sulphitation process, the difference in yield being greater the more refractory and gummy the juices are.

3. By reason of the peculiar conditions obtaining in Natal, both in regard to the nature of the cane and especially to that of the sugar market, the carbonatation process is superior to the sulpho-defecation process from the financial point of view.

4. Sugar produced by the carbonatation process is, as a rule, superior to that made by the sulpho-defecation process. In South Africa, where not only the quality of the sugar but also its uniformity are the main desiderata, carbonatation is the superior process.

5. In spite of the large initial outlay of capital required for the conversion of a sulphitation factory into a carbonatation factory, the manufacture of sugar, under the present conditions in South Africa, is considerably more profitable if carried out by carbonatation than by sulphitation.

From the purely technical point of view it is an indisputable fact that in the manufacture of white sugars the process of carbonatation is superior to that of sulpho-defecation.

From the economic point of view, however, the question of superiority cannot so easily nor so definitely be disposed of. This side of the question is, as we have seen, influenced essentially by two factors, namely :—

1. Does carbonatation sugar command a higher price than sulphitation sugar, and, if so, to what extent ?

2. Does carbonatation produce a higher recovery of sugar from the juice, and, if so, to what extent ?

Now, taking Java, there is not a great difference in quality between carbonatation sugar and sulphitation sugar ; this is mainly due to the comparatively pure juices obtaining on that island and to the highly developed scientific methods, as well as to the careful supervision applied to sulphitation factories. The difference in the prices obtained by the two sorts of sugar is, therefore, correspondingly small.

As to the second point, we have seen in a previous article that, though it is granted that a greater recovery of sugar is obtained by carbonatation than by sulphitation, the actual extent of this additional recovery is still a matter of controversy in Java.

The question of "carbonatation or sulphitation," on that island may perhaps be put briefly in this way. The manufacture of sugar is, after all, a business proposition and as such is carried on for the purpose of making profits ; hence, if the admittedly higher costs of manufacture are not, at least, counterbalanced by other financial advantages, the carbonatation process would have no *raison* *d'être*. In this respect it is interesting to note that during the period from 1910 to 1922 the number of carbonatation factories in Java has increased from 20 to 26.

The conditions obtaining in Natal and Zululand are entirely different from those in Java. Not only is the price commanded by carbonatation sugar considerably higher than that by the average sulphitation sugar; but, moreover, an appreciably greater recovery of sugar is obtained by carbonatation than by sulphitation as compared with Java. As already fully explained elsewhere, these facts are mainly attributed to the peculiarity of the sugar market in Durban and to that of the Uba juices.

Under the present circumstances, there can be no doubt that, both from the technical as well as from the financial point of view, carbonatation is the process *par excellence* as far as South Africa is concerned.

Whether this statement will hold good for the future entirely depends upon what conditions the future will offer. It may perhaps be worth while to say a few words in this respect.

The South African sugar industry enjoys a nett protection on ordinary sugars of 3s. 6d. per 100 lbs., and the following sums up the position :—

> "The industry is now equipped beyond the sugar requirements of South Africa itself, and the probability is that an increasing proportion of the output will have to find a market abroad. The trouble to-day is that the price realized abroad is much less than that in South Africa, and even when more normal conditions prevail, it is indubitable that this will continue although in a less degree. With control removed the price of sugar in the Union will be governed by the landed price of sugar imported from abroad, and the price realized for the surplus output when exported from South Africa must be less at least by the cost of landing it in the country to which it is sent, although the margin between the home price and that realized abroad will probably be much less than it was in the last two seasons. Unless the South African industry can produce sugar to compete abroad with foreign sugar without having to look to the South African consumer to make up at least some of the difference between the home and export price, the expansion of the industry beyond South African requirements may be a very doubtful blessing to the Union." [1]

This extract gives the reader a fair idea of how the sugar industry in Natal and Zululand stands at present. It is evident that sooner or later these countries will have to produce their sugar in open competition with the rest of the sugar world. The question will then arise as to what kind of sugar is the most profitable to make, and whether the factory is suitably equipped to cope with the situation. An uncertain market, which one year demands superior white sugar and the next perhaps raw sugar, does not favour a carbonatation factory; for such a factory does not lend itself economically to switching from the manufacture of white sugar to that of raw sugar (muscovado). On the other hand, if a stable market for superior "mill whites" were assured, (the home consumption being at present about 130,000 tons white sugar annually, a ready market seems to be assured) there can be no doubt that the carbonatation process will more than hold its own against any other process of making direct consumption sugar of the superior white kind.

In conclusion, the writer desires to record his thanks to Messrs. WILLIAM and COLIN CAMPBELL, the Managing Directors of the Mount Edgecombe sugar factory, for their courtesy in allowing him such full facilities to investigate the carbonatation process as carried out in their factory. Thanks are also due to the factory staff, especially the Chemist, Mr. J. RAULT, for assistance kindly rendered.

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[1] Report of the Sugar Inquiry Commission, p. 38.

Methods for the Testing of Decolorizing Carbons, and their Comparison with "Norit."

By J. N. A. SAUER,
General Norit Co., Ltd., Amsterdam.

"NORIT," COMPARED WITH OTHER CARBONS.

"Norit" does not contain any poisonous matter. It is absolutely harmless, and is also used for treating and sterilizing drinking water besides being taken internally for medicinal purposes.

Most other carbons are not of much use for treating sugar for the reason that they are too fine, form impermeable cakes, and do not allow a good rate of filtration. Some decolorize well because of their fine state of sub-division. Many that decolorize well contain hydrochloric acid, a considerable amount of the decolorization being due to the acidifying or neutralizing effect and to the bleaching action due to the presence of the acid.

On a laboratory scale using only a few grams of carbon the property of bad filtration of an active carbon is not easily observed or illustrated, but if the factory filter-presses are used, in which cakes of carbon one inch or more in thickness are formed, trouble with filtration will soon develop with many carbons.

Most carbons, also due to their fine state of sub-division, adsorb more sugar than "Norit," but do not hold the adsorbed non-sugar matter as well. If a 99° purity sugar liquor is treated with "Norit," the average wash water from the cakes after these have been entirely freed of sugar will be bright, brilliant, and colourless, with a purity about 97-98°, showing that very little of the non-sugar adsorbed has been leached out; but if many other carbons are used the sweet-water will often be cloudy and coloured, and will have a very much lower purity (say 60-80°) than the sugar liquor treated even before the cakes are freed of sugar, showing that very much non-sugar matter has been given up to the wash-water. This wash-water cannot be utilized for melting down fresh lots of sugar, nor can it be run along with the clear heavy sugar liquor.

With most of these inferior carbons the practice adopted in bonechar refineries has to be followed, viz., to evaporate all the wash-water separately and boil this evaporated wash-water to low-grade sugars.

GENERAL PROPERTIES OF DECOLORIZING CARBONS.

1. *Filtration Capacity.*—That is the filtration capacity and permeability in the form of a cake of say 1 or 1½ in. in thickness. Most carbons are bad in this respect, showing an inferior rate of filtration even when new, but the more so after having been subjected to a few regenerations, especially by heat.

In the laboratory, using only a few grams of the carbon, the permeability of the cakes cannot be observed. In any case a suction filter should be used of such dimensions that it will allow the formation of cakes at least 1 in. in thickness. The amount of liquor treated and carbon used should be at least ¼ gallon and 50 grms. respectively. The density of the liquor to be treated in the laboratory should be the same as that used in the factory, namely about 60-65° Brix and not lower.

The extremely fine condition of most carbons is due to the manner of their production; and these cannot be made much coarser, and cannot be given a special structure, as this has either been lost during manufacture or was never present in the raw material.

"Norit" particles are coarse as the result of the nature of their structure, and this carbon can therefore be made in any suitable degree of fineness.

All carbons, if they are active and adsorb gums, slimy and colouring matter well, make the treated liquor more easily filtered, but this does not mean that they will form porous permeable cakes. Laboratory experiments where only a small amount of carbon is made to act on a small amount of liquid (say 5 grms. of carbon on 100 c.c. of sugar liquor) will almost always show a good result with regard to filtration and decolorization, for this small amount of carbon builds only a very thin film which will not retard filtration very much. Only when thicker cakes are formed, will this important property of forming easily permeable cakes show up. Extremely fine carbons without a special structure can never form easily permeable porous cakes.

2. Decolorizing Capacity.—This can only be compared with that of other carbons when all the following conditions are observed: (1) Equality of fineness. If one carbon is coarser than another both should be made equal in fineness by grinding and sieving. (2) Equality of reaction. If one carbon is neutral, another acid, and a third alkaline in character, they cannot be compared with each other, for they change the reaction of the liquor. In an alkaline sugar solution, a carbon will adsorb less colouring and slimy matter than in a neutral one, while an acid reaction is the best for decolorizing and degumming.

All the carbons to be compared should therefore first be treated with hydrochloric acid, washed to neutrality, and heated to incandescence. Another way is to use a buffer salt (such as equal amounts of sodium acetate and strong acetic acid) in the presence of which the reaction of the liquid to be tested is automatically (regardless of the reaction of the carbon) practically equalized, and the decolorizing results are then comparable.

Many carbons contain hydrochloric acid, but "Norit" is very slightly alkaline, which cannot do any harm to sugar liquors; moreover, after it has been used once it becomes practically neutral. For this reason it would not be right to compare the decolorizing capacity of "Norit" in its original alkaline state with an acid or neutral carbon.

(3) An isotherm should be determined when testing the decolorizing capacity of a carbon, in other words, in the same amount of one and the same coloured liquid (e.g., sugar solution) varying amounts of the carbons should be used, viz., 0·25 per cent., 0·50 per cent., 1 per cent., 2 per cent., 3 per cent. and 5 per cent. Also the colour of the sugar liquid should be varied, for instance by testing raw and washed sugar solutions. A carbon may adsorb much colouring matter from a dark coloured sugar solution, but only very little from a light coloured sugar solution. Some carbons have only a limited absorption capacity, so that a small amount of the carbon absorbs more colour than a same amount of another carbon, but when the amount of carbon is increased the difference in absorption power may disappear or a reverse order of absorption capacity may be observed.

(4) Other conditions: (a) Temperature of the sugar liquor. (b) Duration of contact between carbon and liquid to be decolorized. (c) Density of liquid. All these should be exactly the same for all tests.

3. Other qualities.—The capacity of retaining the impurities adsorbed during the sweetening-off process is also important and should be determined. Equal amounts of carbons and liquids should be taken, and after filtration and after washing with water, the sweet-water are observed for turbidity, purity, etc. The first wash-water which only removes the adhering sugar solution should be discarded for this test. Fine carbon will have more sugar liquor adhering to its particles than a coarser one, and this is why the first batch of wash-water should not be taken into consideration.

The softness of the carbons and their resistance against breaking down when treated with chemicals and reburned (heated) should be observed. This is very important.

METHODS FOR TESTING.

Acid-soluble inorganic matter.—Treat all the carbons to be compared (say 25 grms. of each dried to constant weight) with 200 c.c. of a 20 per cent. solution of hydrochloric acid, boil for six hours, filter, wash with water, dry the residue at 170°C. to constant weight, the difference being the soluble ash.

Alkali-soluble inorganic matter.—Repeat the above with fresh samples of the various carbons using 200 c.c. of a 20 per cent. solution of caustic soda instead of the hydrochloric acid.

Loss from burning.—Heat 10 grms. of all the carbons to incandescence for six hours in a platinum crucible covered with an asbestos plate and a porcelain lid and determine the loss in weight from burning.

Volume.—As above obtained and treated, the samples are compared with regard to their volume and with the original volume of the untreated samples also dried to constant weight. Weigh a certain amount, say 5 grms., of the fresh and of the treated carbons and measure their volumes in a graduated cylinder.

Mechanical Handling.—The breaking down of a carbon, due to mechanical handling, stirring, pumping, etc., can only be ascertained by actual factory tests. After breaking down a carbon it will occupy less volume, because it becomes more compact. This method is, however, by no means conclusive, for carbons which originally were extremely fine will really become still finer, but the decrease in this volume is not so easily detected, being not so marked as in the case of a coarser carbon.

Screen Test.—A certain weight of all the samples of carbon (the original as well as those treated with chemicals and heat) should, for a more conclusive test, be screened out in fractions of, say 100, 150 and 200 mesh. This test is more certain and reliable.

Other tests.—All carbons should be examined for moisture content, ash, reaction (boiling out, say 25 grms. of each carbon with 250 c.c. of water for three hours, filtering and determining the reaction in aliquot portions of the filtrate using phenolphthalein as indicator) uncarbonized organic matter; and also of heavy metals and other poisonous materials (as zinc, arsenic and cyanide).

Zinc and uncarbonized organic matter can easily be detected by boiling 25 grms. of the carbons with a 10 per cent. soda solution, when the presence of uncarbonized organic matter shows up by the coloration of the soda filtrate. Some carbons, especially those made by the zinc chloride process, will be partly dissolved when boiled with a strong caustic soda solution with the formation of sodium formate.

Zinc will give a precipitate in the soda solution when ammonium sulphide is added. When a quantitative test for zinc is desired, the Kjeldahl method—digesting in strong boiling sulphuric acid—may be used. Arsenic and cyanide are determined in the usual manner.

Ash.—The amount of ash in a good quality of carbon should not exceed 8 per cent. If much higher the carbon automatically becomes finer during reburning, due to the reaction of the inorganic matter on the carbon. A high ash content also decreases the filtration capacity of of a carbon.

Moisture.—This should not exceed 12 per cent.

Reaction.—It should preferably be neutral, but in no case acid, especially should it be free from hydrochloric acid. This can easily be ascertained by boiling, say 25 grms. of the carbon with 150 c.c. of a 1 per cent. solution of pure nitric acid, and then filtering. In a portion of the filtrate the chlorides can be determined by the addition of silver nitrate. The amount is then calculated from the silver chloride formed. A small error may be due to sodium chloride which may have been originally present in the carbon.

Permeability of cakes.—Activated carbons adsorb gums, pectins and other slimy matter and cause the treated sugar solution to be more easily filtered; but the carbon must be of such a physical nature and structure that it can easily be separated by filtration without the aid of another material (such as kieselguhr) and must be able by itself to form permeable cakes, even of 1 to 1½ in. in thickness and by not too high a pressure, otherwise the filtration will be an almost impossible task.

If kieselguhr is added to the carbon, regeneration (either by heat or soda) is almost impossible, as in both cases the kieselguhr breaks down to an impalpable powder that prevents filtration, especially after a few reburnings and treatments with soda. Heating to high temperatures may, moreover, be the cause of clinkering of part of the kieselguhr present in the carbon thus making filtration absolutely impossible.

A Comparison of Filter-Press Results with Single and Double Pressing.

By A. H. ALLEN, Fajardo Sugar Co., Porto Rico.

When scums from the clarification of sugar juices are discharged directly from the presses without being in any way washed while in the frames, and then mixed with water and re-pressed, the operation is termed double pressing.

The advantages and disadvantages of double pressing of cane juice mud have been a moot question for years past, and even yet can not be said to be entirely settled. Such points as the effect of the purities of the juices, the effect on the workability of the after-products, the effect on the losses in the by-products, and the effect if any on the keeping qualities of the sugar, together with matters concerning the cloth consumption, the filtering area required, the amount of dilution necessitated, extra labour demanded, ease of operation, and the re-solution of the gummy substances of the cake, etc., are of vital importance in deciding between single and double pressing.

Standard reference works on sugar manufacture do not give comparative data concerning the problem, so the author thinking that such might be welcome to sugar men now offers for study and consideration the following figures taken from the laboratory records of the Fajardo Sugar Co., Fajardo, Porto Rico.

GENERAL OBSERVATIONS.

Referring to Tables I-IV, it is to be noted that all figures given are for a whole grinding season of five to six months. The single pressing period from 1910 to 1915 covers six years, and during this time sweetening-off of the press cake with hot boiler feed water was practised. A pressure of 45 lbs. was used both for filling the presses and for washing the cake. The temperature of the wash water varied very little from 212°F. Eight 30 in. Shriver, plate-and-frame, side feed presses were used throughout this whole period, and proved ample for a daily grinding capacity of 1800 tons of cane. The average washing time was slightly over an hour.

The double pressing period from 1916 to 1922 represents seven years operation, and during this time (with the exception of 1922) 16 presses were used. The daily grinding rate rose from 1800 tons of cane when single pressing to 2780 tons when double pressing. This increase in grinding rate amounting to about 50 per cent. would have required 12 presses for single pressing, and as 16 presses were used in double pressing, the increased capacity necessitated was 33⅓ per cent. The use of 24 presses might have been anticipated, and as only 16 presses were used the economy in press capacity is clearly demonstrated. The time in washing the cake is economized, and accounts largely for this gain in press capacity. The second presses fill quickly, and give a cake of qualities making for easy and fast discharge.

Occasionally during the years 1920 and 1921 very poor filtering juices were encountered. At these times the press capacity was taxed to the limit, and although ordinarily 16 presses were found to be ample, it was decided to install 4 more for 1922, in order to take care of these peak loads. This gave ample capacity for even the worst condition of poor filtering scum, when grinding about 2800 tons of cane.

As the Fajardo district is noted for producing hard working juices, it is believed that 20-30 in. presses should handle 2800 tons of cane, at almost any factory with ordinary working conditions. Taking 16 presses in double and 12 in single pressing, as a comparative basis when handling 2800 tons of cane daily, the extra capacity required is 33⅓ per cent. If 20 and 12 presses are taken as a basis for the above rate of grinding, then 66⅔ per cent. extra filter press capacity should be required. It is quite probable that a medium between these two figures, i.e. 50 per cent., would be a fair average, and should prove ample in all cases.

Nothing is encountered in these tables that would indicate an ill-effect on the working of the after-products, nor is there anything to indicate that greater losses might be expected in the molasses, or that the keeping quality of the sugar would be injured. Observations covering these points in actual practice do not bring out any injurious effect; in fact, at times during the war years sugars were stored as long as six months without in the least showing any decomposition to the naked eye, which speaks well indeed for double pressing.

JUICE PURITIES.

In Table I there is found a tabulation of juice purities, and drop in purity from the raw dilute and the clarified juices, to the filter press juice; also there is found the rise in purity of the defecator clarified and the mixed clarified (or evaporator supply) juice over the purity of the raw juice.

The average drop in purity from the raw dilute to the filter-press juice, when single pressing, was 4·035; while the corresponding drop in double pressing was 3·161. This shows a slight advantage in favour of double pressing. It is to be noted, however, that the year 1911 is marked by an abnormal drop, due to some unexplainable cause or condition of the juice coming from the mills. Eliminating that year, and giving to it the average drop of the other five years when single pressing, it is found that double pressing still holds its own when compared to single pressing.

Considering the drop in purity between the clarified and filtered juices, we arrive at the same conclusion, namely, that the drop in purity in double pressing is less than in single pressing.

During the period of single pressing only a record of the analysis of the clarified juice as it came from the defecators was kept, while during the period of double pressing only the analysis of evaporator supply juice, or mixed clarified juice, was recorded. In the second case, the evaporator supply juice being composed of a mixture of straight defecator clarified and filter-press juice, it could be expected to be lower in purity, and for this reason the drop between it and the filtered juice should be less than in the case of single pressing. Such is the case, these drops being 4·6 and 3·95 respectively; but if the abnormal year 1911 is disregarded, the difference in the two drops largely disappears as the figure 4·6 is lowered to 4·07 (taking the average drop of 4·0 instead of 7·2 for that year).

Table I.—DATA ON JUICE PURITIES.

Crop.	Raw Juice entering Defecators, Purity.	Clarified Juice from Defecators alone, Purity.	Clarified Juice Mixed from Defecators and Presses, Purity.	Purity of Filter-Press Juice.	Drop in Purity, Raw to Filter-Press Juice.	Drop in Purity, Defecator Clarified to Filter-Press Juice.	Drop in Purity, Mixed Clarified to Filter-Press Juice.	Rise in Purity, Clarified over Raw Juice.
				Single Pressing.				
1910	87·24	87·6	—	82·6	4·64	5·0	—	0·36
1911	85·59	86·2	—	79·0	6·59	7·2	—	0·61
1912	82·84	84·7	—	79·5	3·34	5·2	—	1·86
1913	83·07	83·4	—	79·0	4·07	4·4	—	0·33
1914	84·97	85·2	—	81·9	3·07	3·3	—	0·23
1915	83·88	—	84·6	81·7	2·18	—	2·9	0·72
		Average			4·035	4·9 (Inc. 2·9—4·6)		0·678
				Double Pressing.				
1916	82·21	—	83·0	79·7	2·51	—	3·3	0·79
1917	83·22	—	83·6	80·2	3·02	—	3·4	0·38
1918	84·48	—	85·4	81·3	3·18	—	4·1	0·92
1919	81·79	—	82·6	79·5	2·29	—	3·1	0·81
1920	82·28	—	83·7	78·7	3·58	—	5·0	1·42
1921	82·90	—	83·7	79·5	3·40	—	4·2	0·80
1922	84·15	—	84·5	80·0	4·15	—	4·5	0·35
		Average			3·161		3·943	0·781

Again, considering the rise in purity from the raw to the straight clarified, and from the raw to the mixed clarified juices, the advantage lies with the period of double pressing. The six years' single pressing gave an average rise disregarding 1915, of 0·678 (or including 1915, 0·685), while the seven years' double pressing show a rise of 0·781. It is to be regretted that only a record of the mixed clarified juice was kept for the year 1915. The year 1913 is marked by an exceptionally large rise of 1·86, which has helped greatly in bringing the six years' average rise, single pressing, up to 0·678; the year 1920 also shows an abnormal rise; now if both of these abnormalities are disregarded and averages inserted, the advantage in favour of double pressing is even more pronounced. This is remarkable in that the mixed clarified juice has already been lowered by admixture of filtered juice of lower purity, and therefore a smaller rise in purity, double pressing, ought to be expected. One thing possible, though, is the fact that maybe the rise in purity of the clarified over that of the raw juice may have been increasing slightly from year to year. There is nothing to indicate this, however.

All possible deductions derived from a thorough study of these juice figures, indicate no one ill-effect traceable to double pressing, whilst all general observations would indicate an improvement.

DILUTION DATA.

For the purpose of comparing dilution figures, refer to *Table II*, where again it is not possible to find any objectionable characteristics of double pressing, other than those common to single pressing.

Table II.—DILUTION DATA.

Crop.	Raw Juice entering Defecation, Brix.	Clarified Juice Defecators alone, Brix.	Mixed Clarified Juice from Defecators and Filter-Presses, Brix.	Filtered Juice, Brix.	Dilution per cent. Mixed Clarified, Raw to Clarified.	Dilution per cent. Filter Juice, Raw to Filtered.
			Single Pressing.			
1910	14·538	14·90	—	10·8	—	25·7
1911	14·586	14·60	—	9·0	—	38·3
1912	14·739	15·20	—	9·5	—	35·5
1913	14·505	15·00	—	8·8	—	39·3
1914	14·390	14·63	—	7·8	—	45·8
1915	14·450	14·00	—	7·0	3·1	51·6
Average..	14·535	14·865		8·81		39·37
			Double Pressing.			
1916	14·830	—	14·40	8·8	2·9	40·7
1917	14·510	—	14·20	7·9	2·1	45·6
1918	14·490	—	14·40	8·2	0·62	43·4
1919	14·110	—	13·50	8·4	4·3	40·5
1920	14·310	—	13·90	8·8	2·9	38·5
1921	14·040	—	13·90	8·0	1·0	43·0
1922	13·870	—	13·80	8·0	0·50	42·3
Average ..	14·309		14·014	8·30	2·05	42·0

Uniform dilution on Mud Tanks of 24·75 per cent. Single and Double Pressing.

A uniform dilution of 24·75 per cent. was practised at the mud tanks throughout the whole 13-year period under consideration, and of course all dilution figures calculated from the difference in Brix must necessarily include this, in addition to any added dilution from washing the press-cake, or from double pressing. It is sufficiently accurate to subtract this amount from the dilution figures found, to arrive at an estimate of the dilution at the filter-press station proper.

The total dilution per cent. of filtered juice, for the 6-year period of single pressing amounts to 39·37 per cent., of which 24·75 per cent. is dilution at the mud tanks, and the difference of 14·62 per cent. is the dilution due to sweetening-off the press-cake. Similarly, in the case of double-pressing the total dilution per cent. of filter-press juice is 42 per cent., of which 17·25 per cent. is due to water added to the press-cake in double pressing. Both of the above dilution figures are derived from the difference in Brix of the raw juice and the filtered juice, and include washings of the defecator bottoms and mud tanks, which have been variously estimated at from 2–3 per cent. of the filtered juice. With this constant correction applied (24·75 per cent., plus 2 per cent.) we arrive at a dilution of slightly over 12 per cent., when washing press-cake down to a sucrose content of about 3·9 per cent. and approximately 15 per cent. for double pressing turning out a mud of 1·2 per cent. sucrose, or even under.

A glance at *Table II* reveals that the year 1910 gave a dilution figure, raw juice to filtered juice, of 25·7 per cent. which is abnormally low. If a rough average of 40 per cent. dilution is substituted for this year, the average dilution becomes 41·75 per cent., or very nearly the same as in the case of double pressing. It is true that less than the average amount of wash-water was used in this year, when the company was in its infancy, and had not struck its working stride; for this reason it is only fair to disregard this year in the general average. Even when including it, the increased dilution double pressing is certainly negligible, if it is considered that the total defecator scums only amount to 8–10 per cent. at the most of the raw juice.

A disturbing factor in all the dilution figures is the volume of the chemical precipitate removed in clarification, which may reach 0·15–0·20 per cent. Brix of the raw juice. This error causes, roughly, a 2–2·5 per cent. increase in the dilution figures; but as there is no way of ascertaining its exact value, it has to be disregarded. For our purpose this is sufficiently accurate, only it should be noted that this error is in favour of an increase in dilution.

Unfortunately during years 1910–1914, inclusive, no analysis of the mixed clarified and filtered juice was made, thereby making it impossible to calculate the percentage dilution of the evaporator supply juice. One interesting figure disclosed is the atmospheric evaporation produced using open defecators for clarification, as is shown by the increase in Brix of the clarified juice from the defecators over the Brix of the raw juice, amounting to 2·11 per cent. This is mentioned, as a knowledge of this figure is required in estimating the total dilution per cent. of mixed clarified and filtered juice, for the years 1915 to 1922, inclusive.

The percentage dilution of clarified and filtered juice, during the period of double pressing amounts to 2·05 per cent. (the dilution taken from the difference of the Brix). The real dilution should take note of the evaporation at the defecator station, estimated above to be 2·11 per cent.; or making this correction, the total dilution per cent. clarified juice only reaches the surprisingly small figure of 4·16 per cent.

It is a known fact that relatively large amounts of soluble impurities are mechanically removed from the juice in the operation of defecation, being carried down by the albuminous material and calcium phosphate precipitate, and in a somewhat lesser amount, by the settling out of the fine cane fibre. These impurities are entrained and held in some way not thoroughly known by a combination of absorption and adsorption, which are functions of the temperature, the concentration, and the alkalinity of the juice, and depend on the nature of the chemical or other precipitates produced, and on the properties of the substances producing the precipitates. Probably the largest factor is the concentration, in so far as the effect on filtration is concerned. A very little dillution appeears to cause a relatively large amount of these adsorbed impurities to be dislodged, and afterwards comparatively large amounts of dilution have little effect.

Almost every sugar factory superintendent has noticed this; the drop of purity from the clarified juice to the filtered juice is very nearly the same, whether washing the cake to a 15 per cent. dilution of the filtered juice, or whether washing to a 30 per cent. dilution, or even greater. It is very likely that the dilution at the mud tank station accounts for the larger part of this drop in purity, whether washing the cake is followed or not. It is doubtful from the figures given in *Table I* whether, after deducting the drop in purity due to mud tank dilution, the rest of the drop will amount to more than 1·0 per cent., being the same for both single and double pressing.

The soluble impurities adsorbed by the mud, of course, depend a great deal on the variety of cane, and on the cleanliness of the juice as it comes from the milling department, with respect to removal of fine pieces of fibre by the mill screens. As this fine fibre is materially soluble in the hot juices, any comparison of drop of purities at the press station must be made taking into consideration the amount of fibre entering the defecation department. One factory may show a drop in purity of 4 per cent. with a dilution of 25 per cent., say, on filtered juice, while a second factory may show a drop of 6 per cent. with the same identical dilution. This difference may have been produced, solely, by the second factory less carefully screening the mill juices. Again, the fibre may be of such a nature that it is but little affected. The tendency, however, is strongly in favour of the greater amount of fibre particles in the juice giving lower purity filtered juices.

Analyses of press-cake show there are but very small amounts of highly soluble substances present other than sucrose and glucose. A press-cake analysis given by Prinsen Geerligs as typical of defecation mud follows; also an analysis of double pressed mud from Central Fajardo:—

	Analysis of Press Cake, Single Pressing (Prinsen Geerligs).	Analysis of Press Cake, Double Pressing (Central Fajardo).
Water	69·72	60·331
Sugar	10·20	0·647
Glucose	0·71	0·011
Wax	4·12	7·760
Albumen	1·80	5·775
Phosphate of lime	2·92	1·073
Silica	0·37	6·506 { Sand; Silica
Iron and alumina	1·40	2·666
Magnesia	0·22	0·027
Sand and clay	2·82	—
Undetermined { Organic acids, gums, other organic matter }	5·35	—
Fibre	—	10·860

The soluble substances other than sugar and glucose are to be found in the "undetermined" which will usually run under 6 per cent., or about one-half the sugar-glucose content of the analysis given by Geerligs. In the case of analysis of press-cake from double pressing given by the writer, the magnitude of the "undetermined" is very nearly the same as in the analysis given by Geerligs, despite the fact that the mud has been filtered a second time after the admixture of about 100 part by weight of water. This is surely a severe test of the solubilities of these entrained impurities, for, if further dilution other than that at the mud tanks had very much effect, the analysis of the mud should clearly bring out this ill-effect. This is not the case.

The opponents of double pressing claim the re-solution of much gum, so, even though the above considerations do not in the least bring out this disadvantage, it was decided to analyse the raw juice and mixed clarified juice for their gum contents, to see just how much true gum was removed by ordinary defecation accompanied with double pressing of the scums. An analysis of raw-dilute and mixed clarified juices was made daily for the year 1919 with the following results:—

	Per Cent.
Gum in raw dilute juice	0·1995
Gum in mixed clarified juice	0·0567
Difference (gum removed)	0·1428

From these figures we arrive at the conclusion that 71·58 per cent. of the gums have been removed by defecation. This compares so extremely favourably with ordinary defecation that it is at variance with figures cited by such an authority as Geerligs,[1] who, writing of the effect of ordinary defecation on the gums of cane juices, says: "Gum is not precipitated by lime in slightly alkaline liquids, for a solution containing 15 per cent. of sucrose and 0·12 per cent. of cane gum after ordinary defecation still contained 0·12 per cent. of gummy matter, i.e., the original amount. This percentage did not fall after liming, heating, and treating with sulphurous or phosphoric acids, etc., showing that defecation does not remove the cane gum which is extracted from the cane fibre under heavy pressure."

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[1] See "Cane Sugar and its Manufacture." By H. C. P. Geerligs. Page 145.

It may be added here that gum determinations were made by precipitating with acidulated alcohol, and deducting the entrained ash. The raw dilute juice was settled free of fibre and dirt, and passed through a 350-mesh screen, in order to remove any fine particles of fibre, which if not eliminated would cause an abnormally high gum content.

Undoubtedly, Fajardo juice is of very different gum content than that instanced by Geerligs, and of a different nature as it is precipitable; but the fact that upwards of 71 per cent. was removed by defecation would not seem to indicate much re-solution at the press station. It, therefore, appears to be possible to reduce press-cake to 1 per cent., or under, of sucrose, with the admixture of 100 to 150 parts by weight of water followed by re-pressing; furthermore, it is possible to do so without the re-solution of any appreciable amounts of gum. Figures at Fajardo show that it is possible to reduce press-cake to 1 per cent. sugar with the use of only 100 parts of water per 100 parts of moist first press-cake. This requires, of course, the proper installation for reducing the first press-cake to the same fine state of subdivision, as it originally occurred in the scums, and in so doing, to thoroughly incorporate the added water.

Table III.—Press-Cake Data.

Crop.	Sugar, per cent.	Moisture. per cent.	Press Cake, lbs. per Ton of Cane.	Loss in Cake, per cent. Sugar in Juice.	Loss in Cake, per cent. Cane.
		Single Pressing.			
1910	4·094	58·30	23·4	0·369	0·048
1911	4·122	56·11	25·5	0·424	0·052
1912	3·852	56·30	25·6	0·392	0·049
1913	3·842	53·31	24·4	0·399	0·047
1914	3·760	54·15	25·3	0·392	0·047
1915	3·880	52·71	27·3	0·440	0·053
Average..	3·925	55·15	25·25	0·403	0·049
		Double Pressing.			
1916	1·460	60·11	27·3	0·167	0 020
1917	1·651	56·24	27·3	0·185	0·023
1918	1·010	60·60	27·7	0·111	0·014
1919	1·030	58·99	29·2	0·130	0·015
1920	1·330	59·64	27·6	0·157	0·018
1921	0·990	54·95	23·0	0·096	0·011
1922	1·160	62·56	29·7	0·142	0·017
Average ..	1·233	59·03	27·4	0·141	0·017
	Difference between Single and Double Pressing.				
	— 2·692	+ 3·88	+ 2·15	— 0·262	— 0·032

The period for double pressing shows the following differences when compared with single pressing: Sucrose in press-cake in double pressing is 2·69 per cent. less than in single pressing; with the average content of sugar about 1·2 per cent. for double pressing, 3·9 per cent. for single pressing; the moisture in the press-cake single and double pressing is respectively 55 and 59 per cent., with approximately 4 per cent. more for double pressing; the sucrose loss in press-cake per cent. sucrose in juice (raw dilute juice), is 0·403 per cent. for single, and

0·141 per cent. for double filtration, showing a gain in the latter of 0·262 per cent.; and the sucrose loss in cake per cent. cane amounts to 0·049 per cent. for single, and 0·017 per cent. for double filtration, noting a gain of 0·032 per cent. for the seven years period of double pressing.

This reduction of the loss in the press-cake amounting to ¼ per cent., and upwards, of the sugar in the juice, represents to the cane sugar manufacturer a saving of no inconsequential magnitude. And, as it may be secured by the use of only 33⅓ to 50 per cent. extra labour (shown below in *Table IV*), and with no attendant increase in cloth consumption, it is certainly worth recovering.

In *Table IV*, a comparison of filtering area, and cloth consumption is given. Here, again, we find that the three large items, increase of equipment, of labour, and of cloth required, are not nearly as large as at first hand might be expected.

Table IV.—FILTERING AREA AND FILTER-CLOTH.

Crop.	Cane in tons per day of 24 hours.	Total Filtering Area, sq. ft. per 1000 tons of Cane.	Filter Cloth, yards per per 1000 tons of Cane.	Filtering Area, Single Pressing, sq. ft.	Filtering Area, Double Pressing.		
					Area First Presses, sq. ft.	Area Second Presses, sq. ft.	Total Area, Double Pressing, sq. ft.
			Single Pressing.				
1910	1780	2200	16·11	3920	—	—	—
1911	1840	2130	9·45	3920	—	—	—
1912	1740	2255	9·59	3920	—	—	—
1913	1890	2075	9·62	3920	—	—	—
1914	1590	2465	11·76	3920	—	—	—
1915	1860	2110	14·05	3920	—	—	—
Average		2206	11·76				
			Double Pressing.				
1916	2380	3290	14·67	—	3920	3920	7840
1917	2260	3460	14·30	—	3920	3920	7840
1918	2450	3200	15·00	—	3920	3920	7840
1919	2680	2920	13·64	—	3920	3920	7840
1920	2740	2860	11·00	—	3920	3920	7840
1921	2770	2830	9·16	—	3920	3920	7840
1922	2780	3530	10·89	—	5880	3920	9800
Average		3156	12·67				
		Difference..	+ 0·91				

The average filtering area required in single pressing per 1000 tons of cane ground, for the six years' period 1910 to 1915, is about 2200 sq. ft., while for double filtration during period from 1916 to 1922, there was required an average of about 3150 sq. ft. per 1000 tons of cane handled. It is to be noted that during the years of heavy grinding, 1919, 1920, 1921, the filtering area averaged 2875 sq. ft. per 1000 tons of cane.

The Fajardo district is noted for poor filtering juices, so it is likely that, although at times 2875 sq. ft. of filtering area per 1000 tons of cane was found insufficient to take care of particularly bad juices, it should be ample for districts where the juices possess better filtering qualities. At present there is used about 3500 sq. ft. of filtering surface per 1000 tons of cane, and this is found to be ample for all conditions of good or bad juice.

Comparing filter-cloth consumption, we see that 11·76 and 12·67 yds. per 1000 tons of cane were used in single and in double pressing, respectively. This would appear to be an impossibility because in double pressing about 50 per cent. more filtering area is used. The increased life of the cloth has been found to be due to the absence of washing the cake, in which operation hot water is pumped in under pressure in the reverse direction to the entering mud; the result of which is, to cut the cloths out at the point of entrance of the water. A few times in use, and the cloths in single pressing show this ill-effect of washing. In double pressing, the flow is always in the same direction; consequently the cloths last longer before they have to be thrown out for renewal.

It is very likely, too, that had there been no period of war during the time of re-pressing, when securing first-class cloth was an impossibility, the consumption of cloth in double pressing would not have exceeded that of single pressing. The post-war years 1920, 1921, and 1922 clearly show a decline in the cloth used over the years of war time. Even in the year 1922 when 20 presses were used as against 16 in former years, the cloth consumption was well below that of the war period.

Under the best working conditions the relative filtering surface on front and on second presses is found to be in the ratio of 1½ to 1. Not so much area is required in second as in first, because the volume of liquid handled is much less, and because the first mud after mixing with water is found to filter quicker and better. Less care in setting up presses is necessitated, and less leakage into the mud chutes is experienced at the second than at the first presses. It is probable, though, that the relative ease of filtering depends on the nature of the scums handled, some working easier on second and others on first presses.

Filter presses of the plate-and-frame type usually show quite some leakage around the cloth joints, and at times there may be still another appreciable loss, such as occurs on opening poorly filled presses, when the volume of unfiltered scum and contained juice may carry away sufficient sugar to affect the unknown loss of the factory. Wherever re-pressing is practised, this accidental press loss is of little moment, and may be almost entirely prevented by adding a little more water when preparing the first mud for second filtration. In this way an exhausted cake can always be obtained. This same loss on the second presses is of very small magnitude, because of filtering a liquid very low in sugar. Any frame leakage or the opening of half-filled presses will carry away only a negligible amount of sugar.

CONCLUSIONS.

(1) Double filtration of cane juice scums causes no more drop in purity than washing the press-cake in the frames, nor is there evidence that it causes any more re-solution of gummy substances of the mud.

(2) It is possible with double pressing to reduce the sugar in the press-cake to 1 per cent., using the same amount of water as is required in single pressing to reduce the cake to about 4 per cent. of sugar. Properly conducted, it is possible to reduce the cake in double pressing to 1 per cent. sucrose with only the addition of its own weight of water, or at the most 1½ times its weight of water.

(3) The cloth consumption in double pressing is but little greater than in single pressing, and with care can be held the same.

(4) The increase in filtering area required is from 30 to 60 per cent. of the area used in single pressing; the increase in labour is correspondingly the same.

(5) The accidental loss at the press station from leaky cloths and from opening poorly filled presses is almost entirely prevented. Handling of the press station seems to be improved, and bad filtering scums are more easily handled.

(6) Double pressing will reduce the press-cake loss from 0·25 to 0·50 per cent. of the sugar in the juice (depending on how high a sucrose content single-pressed cake is taken for consideration).

7. Properly conducted, double pressing causes no ill-effect on the after-products, or on the keeping qualities of the sugar.

Recent Work in Cane Agriculture.

SECOND ANNUAL REPORT OF THE PHILIPPINE SUGAR CENTRALS AGENCY. *June 30th, 1923. Manila.*

This Agency appears to comprise six Central factories, five of which are in the west of Negros, the chief sugar island, and one in Pampanga in Luzon. Rapid progress is reported to have been made in the last few years, as is seen from the number of piculs (125 lbs.) of cane dealt with during the past four years. These were 469,709, 1,073,409, 1,462,000, and 1,910,000 respectively, the figures in the third year being somewhat reduced through a typhoon. With certain enlargements of the mills now in progress, their total capacity will reach 2,310,000 tons of cane per season. The capacity of the various Centrals varies from 800 to 2000 tons per day.

The year under review is said to have been unusually prosperous. The crops were on the whole good, costs of production were materially decreased, leaving a good margin between sales and manufacturing expenses, and it is claimed that the "Centrals are now reaching the stage of going concerns." The policy is progressive; manures are purchased and prepared for the planters at cost price, buffaloes are introduced and distributed (1000 during the year), rinderpest has been successfully fought, and a medical Committee in charge of general health has been formed, while all results are given the fullest publicity by means of widely distributed leaflets. A large programme of experiments has been instituted under a qualified plant pathologist, aided by the chemists in the factories, and cane diseases and pests are receiving considerable attention.

As examples of this activity, the following may be mentioned here. Over 6100 tons of artificial manure of a standard mixture (see below) were delivered between December and April to the planters in Negros, while little or none was sent to Pampanga because of the *inquilino* (tenant) system in vogue there, and indifference on the part of the owners. Requisitions for 1923-4 have been received for over 6000 tons of the standard mixture and 2500 tons of ammonium sulphate.

Rinderpest had become so severe in Negros that, early in 1922, as many as 250 head of cattle died of the disease every month, involving a loss of 50,000 pesos (the Philippine peso = 2·59 fr. at par). During that year, with the assistance of the Bureau of Agriculture, inoculations were made with Boynton vaccine, and the affected districts were subjected to a strict quarantine. The result of these measures was at once apparent, the rate of deaths immediately began to decrease rapidly, and the disease is at present unknown in the island.

Swarms of locusts visited Negros from the direction of Quamaras (an island to the east) during May, but the invasion was at once checked by the combined action of the authorities, constabulary, Bureau of Agriculture and planters. The tremendous losses incurred in Laguna (in the south of Luzon) served as an incitement for the total eradication of the pest from that large island also.

The report of H. ATHERTON LEE, who was in charge of the experiments, contains much of interest, and abstracts are printed in the present report.

Varietal tests.—As regards the distribution of new varieties, there was a shortage of seeds, and this is being remedied by the starting of nurseries at all the Centrals. Badila has given superior yields of sugar to the local Negros Purple, and the plots are being ratooned. It is noted also that Badila germinates better and shades the rows more quickly, the cane is thick and straight and therefore less liable to lodging and injury by heavy winds, while it is more easily harvested, loaded, and handled at the mill. On the other hand, its larger buds tend to injure the workers, the cattle appear not to care for the tops as much as those of the local cane, the fibre is short and the cane is therefore difficult to mill, and the bagasse is said not to burn as well.

Fertilizers.—A standard mixed manure is prepared and distributed by the Agency, with 10 per cent. nitrogen, 6 per cent. P_2O_5, and 4 per cent. K_2O. Four tests were concluded during the year with half a ton of this mixture per hectare (2·47 acres) on plant and ratooned canes, with an average increase of 30 piculs of sugar. Experiments are being laid down to determine the best quantity to be applied from the financial point of view. With individual manures results appear everywhere to favour the application of nitrogen, whereas bagasse ash (for potash) and bats' guano (with 15-30 per cent. of P_2O_5) gave no increase in a number of different places, suggesting similar conditions of the soil as regards these elements to those prevailing in most parts of Java and Hawaii. Experiments to determine the need of potash and phosphoric acid in the manure are to be extended. The results with filter-press cake were divergent, but mostly unsuccessful. Copra cake gave a good profit with the present price of sugar.

Considering the pronounced success of nitrogenous manures, extensive experiments are laid down for the testing of the growth of leguminous crops, and two companies are interesting themselves in the preparation of fish meal for tests with this material. Two experiments with lime shell (*caguycay*) have succeeded and steps are being taken to organize its production with a view to reduce its cost. Three methods of application of artificials are being studied. The furrow method wherein the manure is laid in the furrow before planting is the most costly, but planters say that the response to such manures as sulphate of ammonia is very rapid. The "spoon" method is somewhat cheaper, but the Java plan is being largely adopted by the planters and is the cheapest of all. It is especially adapted for quick-acting manure and consists in men making holes with sharpened stakes 3-5 in. deep on either side of the row, while women and boys drop the manure in and cover the holes with the foot.

Cane Diseases.—Having prepared and distributed a simple description of the mosaic disease, efforts have been concentrated on demonstrating to the planters the losses caused by it. As a result of experiments made during the year, losses of 60 and 14 per cent. have occurred through planting diseased sets of Negros Purple, and 40 and 10 per cent. with Badila. These losses were found to be due more to a loss of tonnage than any inferiority in the juice. The spread of mosaic in the Philippines is considered not to be so great as in other countries, since not more than 3 per cent. of the plants are usually affected, and this increases the importance of the selection of sound seed. The power of germination appears to be greatly decreased in the diseased sets. Fiji disease is reported to be becoming serious in the foothills of Negros and is being fought by the introduction of immune varieties. Badila is said to show considerable resistance.

THE TOP-ROT OF THE SUGAR CANE. *Hy. Tryon, Vegetable Pathologist. Bureau of Sugar Experiment Stations, Queensland. Bulletin No. 1. Division of Pathology, 1905. (First printed in 1923.)*

This is to be regarded as more or less a historical document. It was "an enquiry into the nature and origin of a disease affecting the sugar cane in the Herbert and other districts of Queensland," which was not however published. A lengthy summary was prepared by the Colonial Sugar Refining Company and circulated to the staff, and this summary was also printed in the Queensland Agricultural Journal (Vol. XVI, pp. 498-505, May, 1906). As the disease referred to and known locally as Top-Rot or Burdekin disease, is at present of considerable importance in some of the northern districts of the sugar cane area, the Director of the Bureau of Experiment Stations has decided to publish this report, presumably to form a basis for further investigations.

The disease appears to be a particular phase of the root disease of later days. **Tryon** remarks that there are several maladies in which rotting is a feature; and, of the two in which this occurs in the growing point, he separates the one under discussion from that termed "gumming" in Australia, which he considers as probably identical with the Top-rot of Java described by **Wakker** and **Went.**[1] The author soon decides that the immediate cause is a parasitic fungus materially aided by nematode worms, but this diagnosis appears to rest entirely on the observation of fungus hyphae in various parts of the cane tissues and especially in the root tips of diseased plants. No cultures appear to have been made and no inoculation of healthy plants with the hyphae. The bulletin is very lengthy (about 60 pages) and, in the main, consists in a detailed description of the external appearance and internal structure of all parts of the affected plants.

C. A. B.

The Economic Conditions of Cuba.

(Department of Overseas Trade Report.[2])

General.—The year 1923 opened on a note of optimism and a much more hopeful tone was noticeable throughout Cuba. The $50,000,000 loan was received from the United States, the price of sugar rose steadily, and though it has declined somewhat again it is still well above last year's price; the political horizon was not unduly overshadowed, and local industries seemed to be moving towards a return of prosperity. Building which had been dormant since 1920 suddenly sprang into life, and it really seemed as if the crushing trade depression had once for all lifted. However, in spite of these encouraging signs a sense of disappointment is now making itself felt. Business is not as flourishing as it should be, and there is still some severe depression on the local market. It is hard to say why this should be so; some ascribe it to the 1 per cent. sales tax which was recently imposed. Loans are difficult to obtain, and the lack of capital is making itself felt. Unfortunately the increased price of sugar—owing to various factors, especially an anticipated shortage—has caused some speculation which can never be considered as healthy business. In spite of the present slackness the picture now presented by Cuba is a very different one from that of the last three years, and slow as things are at present the improvement has been too definite and too maintained not to argue the best of prospects for the future.

Much interest is evinced in Cuban trading circles as to Great Britain as a customer for Cuban sugar. Trade returns for 1922 show that Cuba has entirely taken the pre-war place of Austria and Germany as supplier of sugar to Great Britain, and the Cuban sugar world generally is hoping that this market will not only be retained but also expanded. A friendly view of British-Cuban trade is established, and the efforts Great Britain has made in the debt settlement with the United States have had a great effect on economic opinion.

It is well that the Cuban commercial world should not lose sight of the fact that Great Britain is a very valuable alternative market for Cuban produce—sugar and tobacco; as this becomes clearer a more lively interest in the United Kingdom as a source of supply will be evident. British trade comes at present second on the table, but a very poor second in comparison with that of the United States of America. This, however, cannot materially be altered; political, economic, geographical and other factors render the United States of America predominant, and the United Kingdom must be content to take second place as a supplier though no effort should be spared to make that place as impregnable as possible.

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[1] De Ziekten van het Suikerriet op Java, Leiden, 1898.

[2] Prepared by Mr. D. **St. Clair Gainer**, Acting British Consul-General, Havana

Sugar.—On sugar the wealth of Cuba entirely depends, and Cuba produces about 25 per cent. of the world's supply. The 1921-22 sugar crop was a record for Cuba, no less than 4,047,236 tons being produced, an increase over 1920-21 of 73,120 tons. Sugar is, unfortunately, one of those staple articles in which there is much speculation in futures. and in consequence there is at all times fluctuation in the price. Towards the end of last year prices showed a slow though steady rise, but it was not until February that any great increase made itself felt.

The first estimates of the 1922-23 crop varied from 4,193,500 long tons to 4,102,857 "with normal conditions." Shortage of labour, accidents to mills, fires and unusual weather conditions soon combined, however, to reduce the estimate which sank to between 3,900,000 and 3,700,000 tons. The publication of the reduced estimate at once made an impression on the market which became "panicky." In the month of February the Department of Commerce in Washington published certain reports which read as if there was likely to be a world shortage of sugar of some 600,000 tons. The result of this publication was wild speculation in futures and prices rose rapidly from 20 to 40 points the day after publication, while the next day the buyers forced up the price 100 points, the maximum allowed by exchange rules. In the following days considerable fluctuation took place and created a situation widely deplored amongst the sound sugar concerns, as it came at a time when sane and safe trading seemed to be Cuba's only chance of complete recovery. Though it has fallen somewhat, the price of raw sugar is higher now than it has been since 1920.

At the beginning of the grinding season there were 182 mills on the active list out of a total of some 192 for the whole island—one was destroyed by fire and nine failed for various reasons to grind. In 1921-22 there were 187 on the active list. Of the total of 192 sugar mills 91 are Cuban owned, 66 American owned, 23 Spanish owned, 5 Cuban-Spanish owned, 3 British owned, 2 French owned, and 2 others owned by international corporations. Raw sugar was quoted and sold in April at 6 cents per lb., and in consequence a surtax of 30 cents per bag was due as from that date. The ordinary tax is 10 cents per bag, but the surtax of 30 cents becomes automatically effective when sugar reaches 6 cents or more.

Alcohol.—The production of alcohol, both pure and as fuel, is rapidly becoming a very important item of Cuban industry. In 1922 the total production of alcohol was almost 50,000,000 litres, of which some 18,000,000 litres were converted into motor spirit. However, this industry has recently been passing through a difficult period due to lack of supplies, and the National Union of Distillers, producing motor spirit, have called the attention of the Government to their position. The Union claimed that for several years they have been working to increase the production of alcohol, and, indeed, have succeeded in doing so by no less than 250 per cent. In the year 1919 alone the output was 21,871,267 litres of alcohol, and this quantity has been gradually increased to its present figures. This increase in production has been effected without Government help of any kind.

The alcohol industry in Cuba possesses 37 distilleries, represents a capital of more than $25,000,000, and employs nearly 3000 men. Its capital is Cuban, and the raw material—molasses—is also entirely Cuban. Since the beginning of 1923 the price of sugar and its residue—molasses, the raw material of the industry—has been increasing, while the exports abroad of molasses have been very much higher than usual. The present supplies are all in the hands of exporters, who are not disposed to sell to the distillers, and the Union have, therefore, been forced to ask Government support for this flourishing industry, the support to take the form of partial prohibition of export of molasses.

Pure alcohol, denatured alcohol, rum, aguardiente and motor spirit are some of the products of this industry.

An increasing number of firms in Cuba, some of very good standing, are betraying interest in British offers and endeavouring to make British connexions, and the increasing buying of Cuban sugar by the United Kingdom is bringing that country more and more to the notice of the Cuban importer as a source of supply.

The Home Sugar Trade during 1923.

Messrs. William Connal & Co's. Annual Review.

Below we give extracts from the annual Report issued by Messrs. WILLIAM CONNAL & Co., the well known Glasgow sugar brokers, on the sugar trade during 1923. In part it relates to the Clyde sugar market.

RAW SUGARS.

The Sugar Market has experienced important fluctuations during 1923. It opened in January with a quiet tone, but in February there was a strong upward movement, which continued, without interruption, till the end of April, and which then established an advance of 14s. per cwt. on the quotation of January. May was undecided, but in June a decline commenced, which lasted till August, and swept away the previous advance. There has since been a gradual recovery, and the closing quotations of Cuban sugars are now about 10s. per cwt. higher than those ruling at the beginning of the year.

During January the market was dull and disappointing. The Cuban crop had been estimated by both Messrs. GUMA and HIMELY as likely to exceed 4,000,000 tons, and U.K. refiners were of opinion that when American wants had been satisfied they would, as in former years, be able then to obtain Cuban sugars on favourable terms. The Cuban quotation at the the close of January was 3⅜, cost and freight, New York, the equivalent of 16s. 9d., c.i.f., for the U.K. This price was, however, found to be too dear against other sugars then obtainable by British refiners—namely Peruvian and Brazil at 16s. to 16s. 1½d., c.i.f., British West India at 19s. 3d. to 20s., c.i.f., the equivalent of 15s. 9d. to 16s. 6d. with preference deducted, and Mauritius at 21s. 6d., c.i.f., the equivalent of 16s. when preference and superior quality were deducted.

In February doubts began to be entertained of the correctness of the Cuban crop estimates, seeing that in the first week of February the Cuban quotation was raised from 3⅜ to 3⅝, cost and freight, New York, and again on the second week to 4 cents, the equivalent of 19s. 9d., c.i.f., for the U.K. Some business was then done for London, in Cuban sugars, at 19s., c.i.f., for March shipment, but U.K. refiners were still enabled to supply their wants on better terms from the other sugars. At the middle of February Mr. GUMA reduced his Cuban crop estimate from 4,193,000 tons to 3,800,000 tons, and an idea was then prevalent that the world's supplies might fall short of its consumptive demands by 250,000 tons. There was in consequence an active speculative demand in America, where, in one day, the terminal market advanced 100 points, and the Cuban quotation was immediately raised to 5½ cents, cost and freight, New York, the equivalent of 26s. 9d., c.i.f., for the U.K. Notwithstanding Mr. Guma's reduced estimate, Mr. HIMELY maintained that he saw no reason to reduce his estimate of 4,195,000 tons, and as he had been fairly accurate in the past, timid operators became alarmed, and dropped the quotation for Cubas to 4¾ cents, New York, the equivalent of 23s. 3d., c.i.f., for U.K. Some sales of Cubas were then also made at 20s. 6d. to 21s. 9d. c.i.f. This weakness was, however, of short duration, as the American market rapidly recovered to 5½ cents, the equivalent of 26s. 7½d., c.i.f., for the U.K.

During March some natural reactions were experienced, but by first hands prices were firmly maintained at about the equivalent of 27s. 6d., c.i.f., for the U.K. This high price enabled sales to be then made to U.K. refiners of No. 17 Javas of the old crop at 27s. to 28s., c.i.f., for immediate shipment, and of the new crop at 25s., c.i.f., for June-July shipment. American refiners continued to make large purchases of Cuban sugar at 5⅝ to 5¾, cost and freight, and sales of both Cuban and Java sugar were being made to Continental Markets.

Early in April the Cuban quotation was raised to 6 cents, cost and freight, and a large business was then concluded with U.K. refiners at from 28s. 3d. to 29s. 6d., c.i.f. This further advance gave rise to renewed doubts as to the size of the Cuban crop. By some extremists it was then estimated at 3,500,000 tons, and by others at 3,770,000 tons. At the end of April, however, new and revised estimates appeared from both Messrs. GUMA and HIMELY—the former reducing his former estimate to 3,670,000 tons, and the latter to 3,725,000 tons. This led to a strong and improving American market, with a large business in Cuban sugar to both refiners and operators at 6⅜ to 6¾ cents, cost and freight, New York, the equivalent of 33s. 3d., c.i.f., for the U.K. British refiners, however, were able to make considerable purchases of other sugars on more favourable terms—No. 17 Javas for June-July shipment at 28s. 6d. to 29s., c.i.f. ; of British West India at 35s. to 35s. 3d., c.i.f., the equivalent of 31s. 6d. to 31s. 9d. with preference deducted ; of Mauritius cargoes for distant shipments at 32s. to 33s., c.i.f., the equivalent of 26s. 6d. to 27s. preference and quality deducted; as well as of many distant parcels of Brazil and Peruvian sugars at full prices. This proved the highest point of the market.

This market was somewhat unsettled at this time by a popular outcry in America against the high price of sugar, and on the terminal market as being the cause of inflated prices. An action against that market was brought before the law courts on 30th April, and adjourned till a week later, when decision was given in favour of the Sugar Exchange.

During May the quotation for Cubas was maintained at 6½ to 6¼, cost and freight, New York, the equivalent of 31s. 3d., c.i.f., for the U.K.—a price above the British market, which was meantime being supplied by large arrivals of British West India sugars on more favourable terms.

Early in June the market had a settled appearance, the quotation for Cubas was 6¼, cost and freight, New York, and as the reaping of the Cuban crop was drawing to a close, it was believed that, high though the price was, it could easily be maintained by holders.

Past experience, however, has often proved that at a high level of values, some unseen and unexpected circumstance is sure to arise and to upset the most careful calculations. In the present case White Javas became the means of changing the entire course of the sugar market. A large speculative business had been done in these sugars during the excitement of April at 30s. to 33s. per cwt. for May-July shipments, and as these were now coming on, along with large consignments by Japanese operators, it was felt that the supply would largely exceed demand. The Japanese had made extensive purchases of these sugars, having the Eastern markets in view for them, but finding no opening in these markets, also America debarred by the extra 2s. per cwt. duty exacted on outside sugars, they made large and continuous consignments of them to London, under the weight of which the market there gradually gave way from 30s. 3d. per. cwt. on 8th June to 20s. on 10th August. This drastic decline of 10s. to 13s. per cwt. had an unsettling and demoralizing effect on all markets, and caused a fall in the Cuban quotation on 17th August to 4 cents, cost and freight, New York, the equivalent of 20s. 4½d., c.i.f., to the U.K. The low price of 20s. for White Javas caused a large demand to arise for them. London refiners in self-defence secured from 8,000 to 10,000 tons, and from all over the Continent there came a demand, even Russia securing 15,000 tons. This caused a rapid improvement in values, and by the middle of September this quotation had recovered to 26s., c.i.f.

From the low level of prices in August all markets have again continued to rally—America especially (the deficiency of whose Cuban crop was beginning t be severely felt) paid high prices for the balance of their sugars, and to augment their supplies became large buyers of full duty sugars—Peruvian, Brazil, St. Domingo, and other descriptions—at prices much above the U.K. parity, and by so doing, they deprived British refiners of their usual supply of these sugars. Before the slump in American prices, several Cuban cargoes afloat and landed in the U.K. were repurchased for New York at prices unobtainable in the U.K. Fortunately, considerable supplies of Mauritius sugars became available at this time for British refiners, laterally at about 30s. to 33s., c.i.f., the equivalent of 24s. 6d. to 27s. 6d., c.i.f. The scarcity of raw sugar has recently been severely felt, so much so that several refineries were compelled to close, waiting adequate supplies.

REFINED.

The number of refineries working in Greenock remains at five. Work for the year did not commence till the middle of January, as there was an accumulation of refined to be disposed of. Thereafter, with the exception of periods in April and December, the weekly meltings were fairly regular. The curtailment in April was caused by refiners' warehouses having been blocked with refined sugars, sold, but held by buyers in anticipation of a reduction in duty. In December the want of raws was the principal cause. Compared with last year, 21,990 tons less were melted

The price of Greenock fine granulated was 49s. 3d. on 2nd January, and by the end of the month it had fallen to 48s. 3d., from the slowness of demand. In February there was a great change in conditions. An amended estimate of the Cuban crop gave a probable reduction of fully 400,000 tons on the original estimate; this caused an excited market, as it was feared that the world's supplies would not suffice till new crop beet became available in October. One week in February recorded an advance of 6s. per cwt. Right on till the end of April prices advanced steadily, and by then Greenock granulated had reached the price of 65s. 3d. During this boom period the trade generally over-bought, and there was great disappointment that the Chancellor of the Exchequer made no reduction in duty. The high prices also checked consumption. These factors brought about the liquidation of stocks held, and prices consequently rapidly gave way until 53s. was reached at the end of August. Very large imports of white Java sugars weighed heavily on the market during August, but, fortunately for the trade, there was a shortage on the Continent, and considerable quantities were reshipped there, thus giving welcome relief to the U.K. markets. The market improved in September and price advanced to 57s. 6d., but early in October a reaction set in, and at the beginning of November the price was back to 54s. 3d. Continental refined sugars were then also arriving in considerable quantities. A reduction of 240,000 tons in Licht's estimate of the beetroot crops imparted firmness to the market, and at the end of November the price had advanced to 60s. 6d. Extreme dulness characterized the market during most of December, with signs of improvement, however, at the close, and the price of Greenock fine granulated at the end of that month was 58s.

Greenock refined sugars have met with a fair demand in England, but trade with the Irish Free State has been greatly hindered by political and labour troubles. Political peace now reigning there, and strikes having been settled, it is to be hoped that soon the Irish trade will show an improvement.

Throughout the year there have been vast numbers of unemployed in the United Kingdom, which has adversely affected the consumption of sugar, but there are now prospects of an improvement in trade generally.

Considerable quantities of foreign refined were imported during the first half of the year. American granulated was sold at the beginning of January at 24s., c.i.f., but fell to 22s. at the end, and thereafter steadily rose till the end of April, when 39s. 6d. was the quotation, although about this time some business was said to have been done at over 40s. for summer shipment. The reaction set in early in May, and by the beginning of August the price had fallen to 28s. Parcels stored in the U.K. about this period were resold to America. The American market has since ruled much above our parity, and indeed for the past few months, with a prospect of a shortage there before new crop Cuban sugars become available, the the export of American granulated to this market has been impossible. For shipment in March, 1924, the lowest quotation has been 32s., c.i.f., quite out of the question compared with 29s. 6d., f.o.b., Hamburg, for March-April Czecho granulated.

Continental granulated was shipped in fair quantities to the U.K. in the early part of the year, but during summer, and up to the time when new crop beetroot became available, very little was imported. Indeed, as already mentioned, the Continent was a buyer of white Javas from this country. It was late in October before Continental granulated began to arrive, and since then imports have been heavy from Belgium, Holland, and Czecho-Slovakia. Shipments of Czecho sugar have been rendered very unsatisfactory from delays in Hamburg. Fluctuations in prices of Continental refined were much the same as in the case of American granulated. The opening and highest prices, and the lowest during the slump in August, were as follows for ready or prompt deliveries :—

	s	d	s	d.	s.	d	
Superior Dutch	22	6	38	9	27	3	f.o.b.
Czecho	22	0	38	6	21	0	,,

The last price given above for Czecho granulated was for November-December delivery. Ready or prompt was not available at this period. Closing quotations were :—

	s.	d.	
Superior Dutch	31	6	f.o.b.
Czecho	30	0	,,

Correspondence.

THE ELECTRICALLY DRIVEN SUGAR FACTORY IN JAMAICA.

THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—In your November issue and under the heading of "The Steam Consumption of Sugar Factory Engines" there is a statement which seems to infer that the electrically driven sugar factory in Jamaica recently built by ourselves, and which by the way is the first completely electrically driven factory to be built by any British firm of sugar machinery manufacturers, was closed down last season owing to its being in some way inferior to a steam driven factory.

We would point out that nothing could be further from the truth, as the factory's not working was due to a matter entirely outside the machinery or the method of driving the mills, and the factory will be in operation during the coming crop.

You would oblige by bringing this to the notice of your readers and so correct any wrong impression that might have been created through the dovetailing of such an unwarrantable remark in what purports to be a technical article.

Yours faithfully,
On behalf of GEORGE FLETCHER & CO. LTD.,
STUART A. McCALLUM (Secretary).

Publications Received.

Diseases of Crop Plants in the Lesser Antilles. By William Nowell, D.I.C., Assistant Director of Agriculture, Trinidad and Tobago. Royal 8vo. 382 pages. With one coloured Plate and 150 Figures in the Text. (West India Committee, 14, Trinity Square, London.) 1923. Price 12s. 6d. net.

In these days of effort at increasing the output of sugar on the plantations, a great deal of attention is being paid to the possibilities of improving the agricultural practice in the fields, and thus producing a greater weight of canes for the mill. A careful study has revealed the fact that serious losses are sustained by prevailing pests and diseases which have long been present and put up with as unavoidable, but that this position is no longer tenable owing to recent work done by entomologists and mycologists. Besides this, new and alarming diseases are constantly appearing, and this book on plant diseases should be welcomed by all of those who take an intelligent interest in the cultivation of their fields. It is not a book solely devoted to cane diseases—that has still to be written—nevertheless, all cane growers will find much to illumine this difficult part of their work. The relations between plants and their fungus enemies which bring about the prevailing diseases are clearly set forth, and what is more satisfactory still, the question of general health and debility in cultivated plants is everywhere carefully considered. There are many factors which affect the quality and quantity of the crop besides the direct attack of insect pests and fungi, and such factors are constantly held in view by the author; thus it happens that, although a fungus disease may be present, there may be other influences at work which are of more importance in reducing the crop, and a great deal of time and expense may be wasted if the true state of affairs is not correctly diagnosed. This view is fully developed in the book, and special attention is paid throughout to the correct treatment of the plant and the soil in which it grows, the suitability of the locality to the crop and to the special variety grown, and a hundred other factors which may make all the difference between profit and loss. The author appears to be a convinced believer in the opinion, which has been gaining ground for many years past, that an investigator studying the pests and diseases of a crop should, besides having a thorough technical training in the scientific aspect of his subject, possess a sound agricultural knowledge of the soil and the crop dealt with, in order to form a correct opinion and thus to be able to suggest the appropriate remedies. The day has now passed when the practical scientist in the field is content with the collection, classifying and naming of the insects or fungi met with, and then giving an *ex cathedra* statement as to the accepted ways of dealing with them. To such a worker nowadays, no factor which could in any way affect the healthiness or vigour of the crop may be neglected, for it has again and again been demonstrated that pests and diseases often only become serious when various laws affecting hygiene are disobeyed. And no one reading Mr. NOWELL's book can avoid this larger, more practical aspect of the question. One might also venture to remark that the day has also passed when the agriculturist can afford to remain in ignorance of the presence and relative importance of the pests and fungus diseases appearing in his fields; and it is for this reason that we heartily recommend the book to all sugar cane planters.

After an introduction on the nature and classification of plant diseases, the first 112 pages are devoted to general essays of the kind mentioned above. Section I of this part deals with the causation of disease (80 pages) and Section II with their prevention and control. The nature of fungi is clearly explained, and the way in which they reproduce themselves and attack plants. Resistance and susceptibility of the host are then discussed, and the effect of agricultural conditions of resistant and immune varieties, and other factors affecting the prevalence of diseases follow. After this a classification of fungi is given, both as to the chief types of diseases as affecting the different organs of the plant, and the chief groups of fungi which are harmful. Shorter chapters are devoted to bacterial diseases, infective viruses, non-parasitic diseases and the relation of insects to plant diseases. In Section II., prefaced as usual by a general chapter, the various fungicides are carefully described, under the main division into copper and sulphur compounds; and special sections are devoted to spraying, dusting and disinfecting.

The second and larger part of the book is devoted to the description of the chief diseases in crops in the tropics, using the Lesser Antilles as a basis, but including a number of important ones which are not yet met with there. It is the duty of the local agricultural mycologist in these days to make himself well acquainted with all such diseases as may by any possibility be introduced into his country, so as to be able to fight against their introduction and to be in a position to combat them whenever they make their appearance. The diseases of the perennial crops are first dealt with, cacao, coconut, citrus, coffee, rubber, and so on. After these the annual crops are taken in turn, sugar cane, cotton, maize sorghum, and bananas, while root crops, leguminous crops and minor fruits are dealt with collectively. Among these, sugar cane holds the premier position, judged by the number of pages devoted to it, and the number of diseases described (twenty five), and the chapter leads off with a somewhat detailed study of root disease. The book is well got up, light and handy: there are a large number of illustrations; and, considering the amount of information contained therein, it is decidedly cheap.

C. A. B

Industrial Alcohol. By John Geddes M'Intosh; second revised and enlarged edition by H. B. Stocks, F.I.C. (Scott, Greenwood & Son, 8, Broadway, London, E.C.4.) 1923. Price: 12s. 6d.

M'Intosh's first edition has been out of print for a time, and anyway called for revision, much of it (culled mainly from foreign works) being of doubtful value to most English readers. Mr. Stocks has now re-edited the book, which is admittedly a compilation from sources which are well known to those familiar with the subject; but he has balanced his matter well, and stated it clearly and for the greater part accuratelv, with the result that he has produced a very useful summary of the most essential facts relating to alcohol, its properties, its fermentation, its distillation, and the purposes to which it is put for manufactures and for power and lighting. As it now appears, the book contains many interesting data on the production of spirit, principally on the Continent, though the chapter on the fermentation and distillation of rum can hardly be judged to represent general practice, the source of the information of the editor being obvious. One of the best chapters is that on distillation and rectification, the development of the construction of apparatus of the simplest type to the modern continuous rectifier being very well done. A good number of illustrations appear, which for the most are well chosen and well executed, but a number taken from standard catalogues leave much to be desired in point of clearness of reproduction. A chapter on the assay of alcohol, the analysis of spirits of various kinds, and on excise supervision, might have been added to advantage in a general work of this kind.

The Supervision and Maintenance of Steam-raising Plant. By Charles A. Suckan. (Ernest Benn, Ltd., London.) 1923. Price: 36s. net.

Contents: Working the power unit; attending to auxiliary appliances; care of subsidiary plant; management of staff; upkeep of power unit; overhauling auxiliary plant; and repairs to subsidiary plant.

Application of the Principles of Jelly-making to Hawaiian Fruits J. C. Ripperton. Bulletin No. 47, Hawaii Agricultural Experiment Station. (Government Printing Office, Washington, D.C., U.S.A.) 1923.

Contents: Methods; guava for jelly-making; effect of varying proportions of sugar, pectin, and acid in jelly-making; other Hawaiian fruits for jelly-making; and consistency of jellies as affected by the physical properties of pectin.

Scientists' Reference Book and Diary for 1924.[1] (James Woolley, Sons & Co., Ltd., Manchester.) Price: 3s. 6d. net.

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[1] For a previous notice of this useful publication see *I.S.J.*, 1923, 40.

Brevities.

Some recent official statistics on Cuba show that the land under sugar cultivation amounts to 1,375,000 acres, valued at $180,000,000. Havana is now a town of 363,506 inhabitants, while the total Cuban population amounts to 3,123,040.

At a recent conference of the Sugar Club of Havana, it was decided that in the future the standard temperature for the graduation of Brix hydrometers for laboratories exchanging information under the Club agreement shall be 17·5° C. About 60 of the larger mills in Cuba are represented by members of the Club.

An interesting statistical study of the contest between cane and beet sugar was recently published by J. van Harreveld,[1] who among many other points raises the question whether beet can ever attain anything like the supremacy it formerly had. It is argued that the beet has to wage a battle against climate. Beet areas have increased, but the tonnage of sugar per hectare has not kept pace, whereas in cane sugar production in several important tropical countries the contrary is the condition now prevailing.

According to a report issued by the Department of Overseas Trade, the production of alcohol from molasses in Cuba as a fuel for internal combustion engines and as the pure product is becoming an important item of Cuban industry. Cuba now contains 37 distilleries with a capital of over $25,000,000, employing nearly 3000 men, its capital being entirely Cuban. In 1919 the output was about 23,000,000 litres, and in 1922 nearly 50,000,000, of which about 18,000,000 were converted into alcohol motor fuel.

It is reported[2] that plans are being formulated for the manufacture of "Celotex" (building boards and box material made from bagasse[3]) in Queensland, Mr. H. C. Armstrong having recently visited Louisiana for the furtherance of this project. It is believed that "Celotex" from which all the lignin has been expressed will be immune from the attacks of white ants, which are so destructive to building material in Australia, and that its insulating properties will make it especially valuable for houses, factories, and stores in that country.

During the 1922-23 season the Cuban-American Sugar Co. produced 1,847,746 bags (263,963 long tons) of sugar; compared with 2,256,736 bags (322,391 long tons) in the previous year, cane ground being 2,324 666 tons, compared with 2,865,584 tons in 1921-22. A high sucrose content was recorded, viz., 12·78, as compared with 12·65 per cent. for the preceding season. Net profits were (after provision for interest, depreciation and taxes) $8,003,148, as compared with only $2,023,447 in 1921-22; and after deducting dividends the sum of $5,950,982 remained for addition to the surplus account, which now reaches $26,403,931.

Gray's Inn Central Factory will probably operate again during the coming season under the supervision of Henckell Du Buisson & Co., of London, whose consulting engineer, Mr. F. P. Rudder, has visited Jamaica for the purpose of organizing the staff. It is proposed to work on a co-operative basis with the cane growers, who, it is stated, will not only be paid liberally on a sliding scale based on the price of sugar, but will also participate in the profits of the factory after the necessary appropriations have been provided for shareholders, renewals, and working reserves.

Mr. W. O. Whaley, who for a number of years has been the Chief Chemist of the Penick & Ford Production Laboratories, has recently resigned to accept a similar position with the New Orleans branch of the United States Alcohol Co. Mr. Whaley will be remembered as the author of several noteworthy investigations, such as those on the use of nickel dishes in the determination of ash in sugar products,[4] and of the density of syrups and molasses.[5] He is well known in chemical circles in his State, having taken a very active part in the New Orleans division of the American Chemical Society.

Mr. Charles M. Warner, President of the Warner Sugar Refining Co., of New York City, died at Syracuse, on December 1st. Mr. Warner was greatly respected in the sugar trade, both in his country and abroad, and his death has been generally deplored. He was a man of remarkable business ability, and during his career took up varied lines of activity, making a marked success of most of them. In addition to refining, he was largely interested in sugar holdings in Cuba, viz., Centrals Amistad and Gomez Mena in the Province of Havana, and Centrals Miranda and Palmarito in Oriente Province. He was also one of the principal owners of the Anaheim beet factory, California.

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[1] *Archief*, 1923, 31, 565-568. [2] *Queenslander.* [3] *I.S.J.*, 1923, 605.
[4] *I.S.J.*, 1923, 329. [5] *La. Planter*, 58, 218.

Review of Current Technical Literature.[1]

Use of Decolorizing Carbon ("Carboraffin") in the Form of Plates. *Oskar Wohryzek. Zeitsch. Zuckerind. čecho-slov. Republik, 1923, 48, No. 10, 73-77.*

One of the methods which have been proposed for the application of decolorizing carbon is to mix the finely divided material to a thin paste with water, to pump this mixture into presses, and to send the coloured sugar liquor through the cakes of carbon thus formed in the frames between alternate cloths.[2] After a time these cakes are discharged from the presses, mixed with water, and reformed, in order thus to give portions which previously had not come into contact with the coloured liquor an opportunity to decolorize. Although the procedure may appear attractive in principle, it has several distinct disadvantages in practice. Making the mixture of carbon and water, and pumping it into the presses, demand a certain amount of time, and also some care; while it is not easy to obtain the even deposition of the cake of carbon in the frames, with the result that the flow of sugar liquor may be irregular, passing through the thinner layers more readily, and making the efficiency of the operation not what it should be. Instead, therefore, of working with decolorizing carbon in fine powder as has hitherto been done, Dr. Wohryzek considers that a great advance in the technique of the application of this material would be achieved by using it in the form of plates of suitable dimensions for insertion in filter-presses, an idea that is borrowed from other industries. Its adoption by refiners and white sugar manufacturers might have several advantages, among the most important of which appear the following: Manipulation would be cleaner and easier, and labour more economical; loss of carbon would be avoided; and economy of filter-cloth would result. In practice the procedure would be preliminarily to pass the liquor under treatment through a press containing plates exhausted in a previous operation; and to send the clear filtrate through another press containing fresh carbon plates, the flow through which is reversed after a time. Finally, when the plates are exhausted they would be washed free of sugar and other soluble matter and regenerated, this operation preferably being in the hands of the manufacturers of the carbon. Regarding the formation of the plates, it is explained this could be done by mixing the fine carbon to a dough with a suitable binding agent, as glue water, bullocks' blood, or sugar syrup; by moulding the dough to plates of suitable size with the application of high pressure; and lastly after drying by kilning them at white heat to effect the complete carbonization of the organic binding material.

Comparative Rate of Moisture Absorption of Plantation White and Refined Granulated Sugars. *W. L. Owen. La. Planter, 1923, 70, No. 22, 469-471.*

Complaint is being made in Louisiana against plantation whites because they are much more hygroscopic than refined crystals and therefore are more subject to deterioration, which imparts to them a very dull grey cast, or results in the clumping of the crystals on subsequent drying. In order to investigate the matter a large number of samples of plantation white sugar were collected from different factories in the State, and after analysis these were examined in regard to the amount of water taken up when exposed to an atmosphere of 100 per cent. humidity and also to one of lower humidity, a sample of the highest grade of refined granulated being exposed in each test under identical conditions, and the results obtained expressed as a ratio of the moisture increase per cent.; using the value for the refined sugar as unity. In the case of exposure to an atmosphere having a humidity less than 100 per cent., the average ratios obtained after 24, 48, 72, and 96 hours were 1·87, 1·21, 1·12, and 1·40, that is a general average of 1·34. But it is to be noted that a certain percentage of the p. w. sugars absorbed less moisture than did the refined granulated, these percentages for the periods named being 28, 42, 35, and 21. Incidentally it is also noticeable from the analyses given that the moisture content of most of the samples of p. w. sugars was initially very low, lower than that of the refined sample-in many instances. Dr. Owen's opinion is that the moisture absorption of p. w. sugars is determined less by the minute quantities of non-sucrose solids present than by the size of grain,[1] and more particularly by the uniformity of grain and presence of broken grain and fine dust, and, therefore, he does not offer this moisture absorption ratio as a criterion of of their value as compared with refined. It is possible for a sugar to have a high rating in this connexion, and yet be very inferior in colour and lustre, though (as the results obtained strikingly show) this is very improbable. It is of great significance to observe that the samples that proved superior to the refined granulated in rate of moisture absorption were from houses in which the manufacture of this class of sugar has been thoroughly standardized, and in which the production is notably constant in composition, the deduction from which observation is obvious.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] German Patent, 317,449; *I.S.J.*, 1921, 113.

CONTROLLING THE LIMING OF CANE JUICE BY THE DETERMINATION OF THE HYDROGEN-ION CONCENTRATION. *W. J. Williams and J. A. Gebelin. Facts about Sugar, 1923, 17, No. 9, 202.*

Using the same directions and the same set of indicators as were advised by BREWSTER and RAINES in their recent article,[2] the authors have applied *pH* control at the liming station of the Central San Isidro, Santo Domingo, and have made a number of useful observations. In regard to the lowest *pH* value to which one can lime without danger of inversion, this was found to be about 6·8. A good clarification was obtained with a very wide range of the *pH* concentration, namely from 8·5 to 6·0, though at the lower figure inversion was feared. Cane from different fields required liming to different *pH* values to secure a good settling, that from younger fields giving a brighter juice, capable of settling well at a lower *pH* value than that from the older colonias. On raising the *pH* by the addition of lime, the colloids were seen gradually to coagulate until a point was reached at which they settled rapidly, leaving a clear juice above them. When the *pH* value was increased above this point, the colloids were noticed to swell and increase their hydration, thus occupying a much larger bulk, while with some juice a point was reached at which settling could hardly be effected at all. It is interesting to note that in liming to alkalinity to phenolphthalein, one makes certain of avoiding inversion, as then the *pH* concentration is carried to over 8·2, and that in liming to a slight acidity to this indicator the value is still over *pH* 7·0; while with litmus one gets still closer to *pH* 7·0. Concluding, it is remarked that the addition of lime should be carried to the *pH* value at which the maximum coagulation takes place, assisted by the temperature to which the juice is heated, and by the agitation in the heaters and defecators.

ALKALINE, ACID, AND NEUTRAL CLARIFICATION AT THE LIMING STATION. *B. Sandmann. Facts about Sugar, 1923, 16, No. 14, 274.*

Recently there has been developed a tendency towards the alkaline liming of cane juices. According to the author it is a retrograde step, which carries no advantages, and is one which is likely sooner or later to start a reaction in the refiners' camp. It may diminish the sucrose loss by inversion, but this is off-set by the production of a final molasses of higher purity. It is maintained that an acid clarification is necessary in raw sugar manufacture, and a neutral one if a sugar for direct consumption is the end in view. In raw sugar production, the main consideration is to make an article that lends itself easily to the refining process, which is accomplished when the acids in the juice are not all neutralized. In acid liming, the acids forming insoluble calcium salts are precipitated at once, and the remainder can be safely left alone, their hydrolysing power being so small; while the result of such a clarification is a light coloured sugar, which requires a smaller amount of bone-char than would have been necessary had an alkaline liming been employed.

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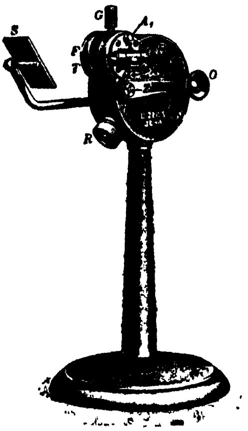
[1] Dr. OWEN does not state in his analytical figures the "glucose" content of the various p.w. sugars examined by him.—ED., *I.S.J.*

[2] *I.S.J.*, 1923, 88.

Coming now to the clarification of juice for direct sugar consumption, it is remarked that if insufficient lime has been added the result is a syrup which is cloudy, and liable to deposit insoluble matter in the vacuum pan ; but a neutral clarification reduces this formation of insoluble matter during concentration. Juice only slightly limed settles rapidly, though its deposits offer difficulties in filtration. Fortunately, however, there are cheap filter-aids (e.g., kieselguhr), which will overcome this very trouble.

IMPROVED ZEISS SUGAR REFRACTOMETER. *H. C. Prinsen Geerligs. Indische Mercuur, 1922, 860 ; Archief, 1923, 31, No. 9, 203-204.*

DR. PRINSEN GEERLIGS here gives a few particulars of the new Zeiss refractometer for use in the sugar industry, which has been so modified that an entirely different instrument has been designed[1], and so improved as to be free from the less satisfactory features alleged to belong to the former pattern. To begin with, the telescope *O* through which observations are made is now horizontal, and is mounted at such a height that the operator while sitting at a table looks into it very much in the same way as in the case of a polarimeter. In the second place, the double prism *F T*, between the surfaces of which a drop of the product under examination is placed, is uppermost, and not below as in the old type, so that one may remain seated while opening, closing, and otherwise manipulating the double prism. But the optical construction of the instrument has been greatly altered. In place of the cross-lines, the field of view now shows a circle with its centre marked by a small black dot, while on the right of it is the scale showing the percentage of sugar from 0 to 50 per cent. in fifths and thence to 97·5 per cent, in tenths, while there is also a scale on which appears the refractive indices from 1·330 to 1·540. Lastly, it is mentioned that the new apparatus possesses a prism compensator, by means of which a colourless boundary line can be made to appear when examining, not only sugar solutions, but also oils, petrol, turpentine, and salt solutions. One can work either with direct or with reflected light, which latter mode of illumination is necessary for very dark juices and syrups, and this modification in the light is effected simply by adjusting a mirror, *S*. As to the source of light, this may be either diffused daylight or else an electric lamp of 25 or 30 c.p., provided with a frosted bulb.



FORMATION OF FORMIC ACID BY THE CARAMELIZATION OF SUCROSE. *Stephen G. Simpson. Industrial and Engineering Chemistry, 1923, 15, No. 10, 1054-1055.*

Sucrose in 10 grm. portions was heated in loosely stoppered tubes in an oil bath at varying temperatures for different periods of time, and the formic acid in the caramelized or partly caramelized product determined by Fincke's method,[2] some of the results obtained being as follows :—

Temperature, degrees C.	Time of heating, mins.	Appearance of sugar after heating.	Formic acid, per cent. sugar.
145	20	Slightly yellow but still granular	none
167	20	,, ,, ,,	,,
180	20	Entirely melted, yellow to brown	0·008
195	20	,, brown	0·063
220	20	,, black	0·401
243	20	,, black	0·500

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[1] See also *I.S.J.*, 1921, 642.

[2] *Zeitsch. Nahr. Genussm.*, 1911, 21, 1 ; 1912, 22, 88 ; 1913, 23, 255 ; 1915, 25, 386. Also *Biochem. Zeitsch.*, 1913, 51, 253.

Review of Current Technical Literature.

PRODUCTION OF ALCOHOL FROM MOLASSES. *W. L. Owen. Facts about Sugar, 1922, 14, 478–479; 15, 10–11, 54–55, 92–93.*

This series of articles includes a statistical study of the alcohol industry in Europe and the U.S.; and discusses the following technical matters: theoretical and actual yields obtainable from blackstrap; and the extent to which they are affected by the addition of various amounts of acid.

HILDEBRANDT'S PROCESS FOR THE UTILIZATION OF CANE AND BEET MOLASSES AS FUEL AND FOR THE EXTRACTION OF POTASH. *Oswald Wilson. Communication from the Editor of the Sugar Beet Journal, San Francisco, Cal., U.S.A.*

Dr. PAUL G. HILDEBRANDT, chemical and mechanical engineer of Swarthmore College, Pennsylvania, has been granted patents in the United States and abroad for his method of treating molasses from beet and cane factories so as to make it suitable for consumption as fuel, and at the same time recover potash as a by-product. At the research laboratory of Swarthmore College the value of this invention has been demonstrated; and it has been shown that from each ton of low-grade molasses subjected to the process a fuel having a heating value equivalent to a ton of coal is obtained and 150 lbs. of commercial potash besides. A factory may spend each year from $50,000 to $60,000 for fuel, and from $75,000 to $100,000 for commercial potash for fertilizing purposes, making the investment for both fuel and potash amount to about $150,000; but if the Hildebrandt process were utilized the following results may be expected: one million tons of crude molasses, when converted into a fuel equal to coal selling at $15 a ton represents a saving of $15,000,000; while the production of 75,000 tons of potash a by-product of the fuel, valued, say at $100 a ton adds $7,500,000, a total saving of $22,500,000.

ACTIVATED (DECOLORIZING) CARBON. *Arthur B. Ray.*[1] *Chemical and Metallurgical Engineering, 1923, 29, No. 9, 354–357.*

This article deals with the application of activated carbons to the industrial adsorption of gas and vapour, and discusses the following matters: Essential characteristics of gas-adsorbing carbons, as physical structure, sorptive capacity, selectivity of adsorption, recovery of sorbed vapours and gases; commercial applications of gas-adsorbing carbons, e.g., for the separation and recovery of gases and vapours (benzol, petrol or gasoline, petroleum ether, sulphuric ether, alcohol, and industrial stenches), the storage of gases, catalysing reactions, and for obtaining high vacua.

METHODS FOR THE PREPARATION OF THE RARE SUGARS (MANNOSE AND INULIN). *T. Swann Harding. Sugar, 1923, 583–585, 636–638.*

Previous work on the preparation of these carbohydrates is summarised, and to this information are added the methods preferred by the writer,[2] these articles now concluding his series of contributions on the subject.

ANALYSIS OF MIXTURES OF SUCROSE AND INVERT SUGAR OR LACTOSE. *H. Jessen-Hansen. Comptes rendus Trav. Lab. Carlsberg, 1923, 15, No. 3.*

As is known, the quantity of cuprous oxide deposited by a mixture of sucrose and a reducing sugar, or of two reducing sugars, is not equal to the sum of the quantities which each sugar would deposit if it were present alone. A series of analyses have been carried out to determine the amount of copper deposited under definite conditions by: invert sugar; mixtures of invert sugar and sucrose; lactose; and mixtures of sucrose and lactose. Formulæ covering the experimental results obtained were deduced, and tables compiled from these formulæ. Details of the method of working adopted are given, and concrete examples of the use of the tables are also presented.

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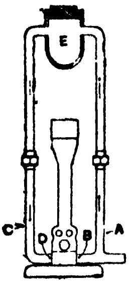
[1] Union Carbide and Carbon Research Laboratories Inc., Long Island City, N. Y.

[2] See also his previous contributions: *I.S.J.*, 1923, 497, 663.

DEVICE FOR THE PRODUCTION OF SODIUM LIGHT FOR USE WITH POLARIMETERS. *A. O. Jones.* *Journal of the Society of Chemical Industry, 1923, 42, No. 48, 459-460T.*

An intense, steady, monochromatic (e.g., sodium) flame, which will last for a considerable time, is said to be obtained by the device shown in the illustration. It consists of a steel crucible *E*, conveniently turned from a piece of shafting, closed by a screw cap (such as is used on lead waste pipes) and supported by its inlet and outlet tubes over the burner at such a height that the flame plays on the bottom of the crucible. The T-tube *A* is fixed to the burner at the blank end *B*; tube *C* replaces the ordinary inlet tube of the burner and is screwed into the burner at *D*. For a 1 in. Meker, convenient dimensions for the crucible are: external diameter, 1½ in.; internal diameter, 1¼ in.; internal depth, 2 in.; holes for inlet and outlet tubes diametrically opposite, with centres ⅝ in. from top of crucible; bottom of the crucible, 2 in. from top of burner. The screw cap should have an easy fitting thread, and can be made gastight by an asbestos washer if necessary. To use the burner it is only necessary to put some easily volatile salt (sodium nitrate is convenient) into the crucible and screw the cap down hand-tight. A short time after lighting the gas the salt volatilizes, and an intense monochromatic flame is obtained.



EFFECT OF POLARIZED LIGHT ON THE FORMATION OF SUGAR IN THE PLANT.[1] *Elisabeth S. Semmens.* *Chemistry and Industry, 1923, 42, No. 40, 954.*

Starch is formed in the leaves of a plant to about 6 p.m. (in countries of the latitude of the U.K.), and after that time the formation of sugar becomes more evident. As the vertical light from the evening sky is polarized, it seems possible that the above change (like many others in plant and animal life) may be due to a specific action of polarized light. Plane polarized light has been found by the authoress to cause a definite acceleration of germination. She placed equal amounts of mustard seed in three glass dishes, and watered each, the first being subsequently exposed to plane polarized light, and the second to ordinary light, while the third was kept in the dark. Determination of the amount of sugar in each of the three portions of seed indicated that an increased hydrolysis had been caused as the result of the effect of the polarized light. In another series of experiments, washed starch grains were shaken up with water and with the enzyme diastase, these being placed on three slides, which were mounted on three microscopes, the first and the second being illuminated with beams of plane polarized and ordinary light, while the third was completely covered, equality of temperature being controlled by means of a delicate thermo-couple. It was observed that with polarized light the grains had broken up (indicating conversion to maltose and malto-dextrins); that with ordinary light only a slight erosion was apparent; and that in the third slide (which had been kept in the dark) no effect had occurred.

USE OF PUMICE STONE FOR THE DETERMINATION OF DRY SUBSTANCE OF SUGAR PRODUCTS. *Armin Seidenberg.* *Journal of the Association of Official Agricultural Chemists, 1923, 7, No. 1, 98-106.*

In the determination of the total solids in syrups, molasses, massecuites, and other such products, a solution of the sample is absorbed upon some finely divided material, and frequently pumice is employed. It is pointed out in this article that if the pumice is heated to redness before being used in this way, and all its moisture thus expelled, an approximately constant weight may at times be obtained due to the balancing effect of two opposing errors, viz., one due to the gain in weight resulting from its adsorptive power; and the other due to the loss in weight produced by the decomposition of the organic matter. This constant weight may or may not be correct, and checks can usually be secured only by preparing all the pumice used under identical conditions.

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[1] Abstract of a paper read before Section B, British Association Meeting, Liverpool September 18th, 1923.

Review of Current Technical Literature.

Sterilization of Juices and Liquors by Treatment with "Filter-Cel" (Kieselguhr) for the Purpose of producing Sugars of Good Keeping Quality. Robert Calvert and Alfred Knight. *Facts about Sugar, 1923, 17, No. 8, 178-179.*

Kopeloff has found[1] that as the result of clarifying cane juice with kieselguhr, a large proportion of micro-organisms were removed, the fungi being in fact separated entirely, while the bacteria remaining in the filtrate varied from 0·004 to 1·17 per 100 originally present. Similar tests have now been made by the authors. They used a raw cane liquor at 60° Brix, and judged the degree of sterilization by the comparative rates of fermentation (as exhibited by the volumes of CO_2 collected before and after the treatment), the procedure being to mix the liquor with 1 per cent. of "Filter-Cel" kieselguhr at a temperature of 80° C., to filter in a sterile Buchner funnel dressed with cloth, to incubate at 30-40° C. both filtrates and untreated liquors (the latter having also been heated to 80° C.) and lastly to note the formation of CO_2. In another series of tests, the amount of kieselguhr added was 6·8 per cent., and filtration was conducted in a laboratory Sweetland press; while in some of the experiments the liquors were diluted to 12° Brix before incubation. Data were thus obtained indicating that filtration with "Filter-Cel" is quite effective in removing from juices and liquors those organisms capable of effecting decomposition with loss of sugar. Heating alone to the temperature used in commercial filtration did not prevent fermentation, this operation in fact increasing the CO_2 development, due possibly to the formation of invert sugar at the comparatively high temperature employed. All the untreated liquors showed a considerable evolution of gas on incubation, whereas those filtered with this special grade of kieselguhr showed no sign of fermentation within the period of the test.

Boiling System for the Production of 96° Raw and Carbon Refined Granulated. S. George Chiquelin. *La. Planter, 1923, 70, No. 22, 480-482.*

In reference more particularly to Louisiana conditions, the author advocates boiling equipment for the production of both 96° raw and carbon refined granulated sugars, using a 2-massecuite system, as follows:—No. 1 massecuite would run about 93–94° Brix with a purity of 70–72°, which, after 18–24 hours in crystallizers, would on purging give a molasses of about 42–45° purity. A footing would be taken from pan 1 to pan 2, which would be filled with the 42–45° molasses to give a massecuite of about 55°. This No. 2 massecuite would be kept in crystallizers for 3–4 days, and on purging would give a final molasses of 25–26°; while the second sugar would be mingled with syrup and returned to a *malaxeur* to be drawn into pan 1, where it would be built up with syrup for the production of No. 1 massecuite, which, if desired, would be bagged as 96° raw. Or if standard granulated is demanded, this first sugar would be washed and remelted, so as to give a liquor of about 30° Bé. (55° Brix) and of about 99° purity, which would be treated with decolorizing carbon for not less than 15 mins., sent through presses, and boiled to standard granulated.

Specification of a 1000-ton Balanced Cane Factory. J. O. Frazier. *La. Planter, 1923, 70, No. 22, 474-478.*

A sketch is given of "a lay-out which embodies the nearest practical application of what might be called a straight line transit of the product with minimum retracing of path." The building shown is rectangular, and is divided into mill and boiler section and sugar section, the latter being three-storied. Dimensions and capacities of the plant, which includes a 34 in. × 72 in. crusher and three 3-roller mills, each 34 in. × 72 in., are stated.

Beet Sugar Manufacture in Holland. Emile Saillard. *La. Planter, 1923, 70 No. 22, 492-493.*

A description is given of two Dutch beet plants, in one of which the "Norit" process is in operation, and in the other of which the Asselbergs continuous carbonator[2] is installed.

J. P. O.

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[1] *La. Planter*, 1920, 64, 14-15.

[2] *I.S.J.*, 1920, 292.

Review of Recent Patents.[1]

UNITED KINGDOM.

Furnaces for Burning Bagasse, and other Low-Grade Fuel. *William A. Gilchrist,* of Chicago, Ill., U.S.A. *204,244.* March 21st, 1922.

In the successful burning of low-grades fuel, such as bagasse, lumber waste, lignite and peat, it is necessary that, in addition to provision for securing complete combustion of the volatile constituents of the fuel, and utilizing the heat so produced with the greatest efficiency, there must also be provision for directing some of the heat back upon the fuel bed, since it is only by so doing that drying and destructive distillation will be sufficiently active in the fuel bed for the burning of relatively large amounts of fuel in a furnace of a given size. In the construction shown in Fig. 1 the fuel is fed into the furnace through a hopper *21* arranged in an inclined arch *15* above the grate, at the rear of which is a large combustion chamber *22* bounded by a forwardly-facing wall *16* extending upwards to a level above that of the front end of the fire-box. The wall *16* becomes incandescent, and from the portions of this wall both above and below the level of the front end of the fire-box, heat is radiated upon the fuel bed both directly and by reflection from the arch *15*. The whole of the air supply to the furnace is delivered through the grate. The floor *23* of the combustion chamber may be at (or slightly above) the grate level, and the flat grate *13* may be replaced by an inclined grate. When fuels producing a long flame are used, the flue passage leading to the boiler may be longer than as shown in Fig. 1, or it may be formed with two right-angled turns. When the furnace is applied to a vertical water-tube boiler the outlet flue may lead rearwardly from the combustion chamber, or first vertically and then rearwardly, and this latter form of outlet is also used when the arch above the grate is horizontal. In the construction shown in sectional plan in Fig. 16, in which the grate is of considerable width, the feed openings are so arranged in the arch that five piles of fuel are formed on the grate, the two piles *59* at the front being staggered relatively to the three *60* at the rear. The unoccupied front corners of the fire-box then form auxiliary combustion chambers *62*, *63*. In the construction shown in Fig. 10, the forwardly-facing wall *40* at the rear of the combustion chamber, and the arch *41* above the grate, are curved as seen in vertical section, and when this form is adopted the side walls may be rounded so that the furnace is substantially elliptical in plan. Three charging hoppers are then provided, one at each side of the outlet flue *49*, and one in front. In some cases the rear wall may be curved as seen in horizontal section only, and in one form of furnace described a vertically-curved rear wall is used in conjunction with an inclined arch above the grate. In another form, Fig. 13, the furnace

FIG I.

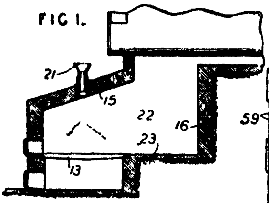


FIG 16.

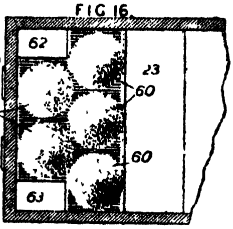


FIG 13

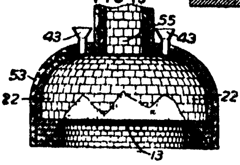
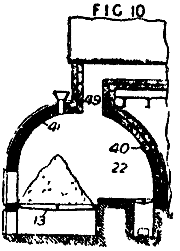


FIG 10



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

consists of a circular dome *53* with a central grate *13* surrounded by an annular combustion chamber *22*. The outlet flue *55* is also central and around it are four symmetrically-placed feed hoppers *43*. Specification 8299/09 is referred to.

DISCHARGING DEVICE FOR CENTRIFUGAL MACHINES. *Andrew R. Robertson and Alexander F. Dunsmore*, of 98, Dundas Street South, Glasgow, Scotland. *204,937*. November 1st, 1922.

This invention relates to discharging devices for centrifugals, of the kind in which the plough is secured on the lower end of a spindle vertically movable within the revolving basket and carried in a horizontal arm secured to the outer stationary or monitor casing, so that whilst the plough is within the basket it does not rotate therewith. It has for its object the provision of simple and effective means for moving the plough device into and out of engagement with the material in the basket, and for so positioning and supporting it that the objectionable tendency which it has in certain constructions to dig more deeply into the material upon its meeting an obstruction is avoided. Referring to the drawings, at *23* (Fig. 4) is shown the plough, which is mounted on a spindle *12* (Fig. 1) vertically movable in a member *1* which is in turn movable radially of the drum in a casing *2* fixed to the monitor casing *26*. The member *1* is formed with a rack *3* which gears with a pinion *4* on a shaft *5* and also acts as a feather to prevent rotation of the member *1*. The shaft *5* is actuated by a handle *6*, and a spring-pressed plunger *8* in it co-acts with a recess in the casing *2* to hold the device in its inner radial position. A rack *14* on the shaft *12* is actuated by a pinion *17* on a sleeve *16* held from axial movement in the member *1*. A shaft *19* keyed to the sleeve *16*, but axially movable relative thereto, is prolonged outside the casing *2* and carries a hand-wheel *21* which may be locked by a catch *22*. The nose *24* of the plough *23* (Fig. 4) is behind the drum radius *b—b* in the direction of rotation.

FIG.1.

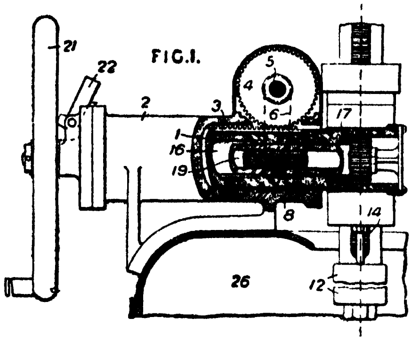
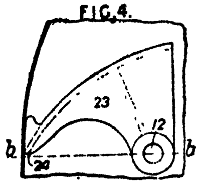


FIG.4.



EVAPORATOR. *Soc. des Condenseurs Delas*, of rue St. Lazare, Paris. *201,123*. October 24th, 1922; convention date, July 21st, 1922.

Liquid is forced by a pump through the tubes of a heater, the headers of which are divided by baffles, so that it passes in succession through the separate rows of tubes and between each passage and is discharged into an open vessel, from whence it is returned to the pump for re-circulation.

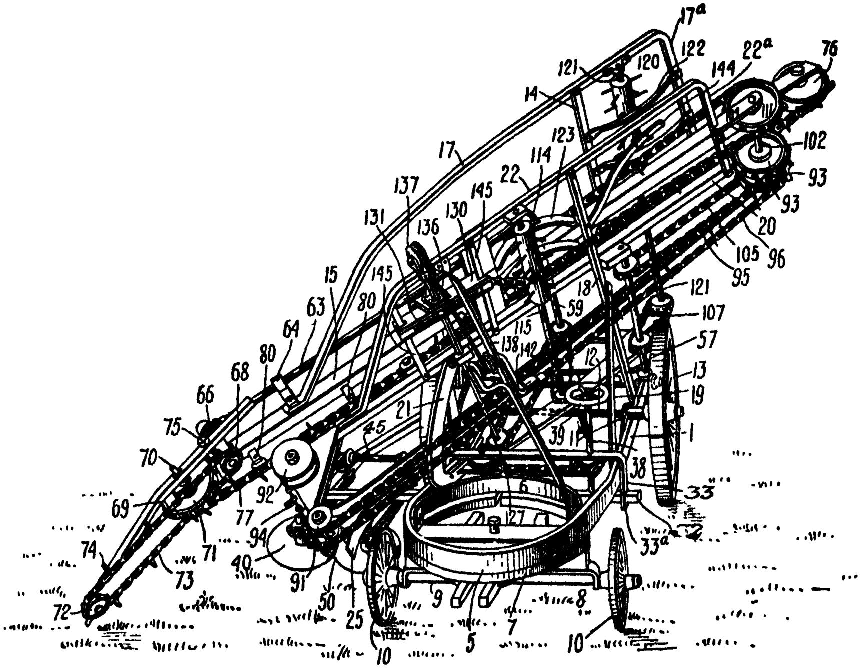
MANUFACTURE OF LOAF SUGAR FROM GRANULATED. *Pierre Sigean*, of Montrouge, Seine, France. *192,394*. January 24th, 1923; convention date, January 24th, 1922.

To form white granulated sugar into loaves, slabs, and the like, it is melted with about 9 per cent. of water at from 90–98°C. in a jacketed vessel furnished with stirrers. This melt is then run into moulds and the resulting blocks or slabs treated in centrifugal machines. The syrup spun off is added to a second or third boiling and then dried to give powdered sugar, icing sugar, etc. This drying is preferably effected in two stages, first in the open air, and secondly on perforated trays passing through a tunnel in counter-current to a stream of hot air.

UNITED STATES.

CANE STRIPPING MACHINE. *George D. Luce* (Assignor to *Luce Cane Harvester Corporation*, of New York, U.S.A.). Reissue, *15,616* (original, *1,053,917*), Reissued, May 29th, 1923; originally issued, February 18th, 1913. (Ten drawings; 44 claims.)

In the operation of this machine, the whole is advanced through the standing cane in such a way that the cutters or discs *40* present themselves to the row of cane. If the cane should have fallen down, the extension *69* on the forward end of the main guide bar *15* operates to raise it, so as to enable the cane stalks to be cut off. As the cane stalks are cut off, they pass rearwardly into the guide space between the guide frames, and are advanced along the same by the chains *77* and *94*. As the stalks advance in this way, their upper ends come under a guide bracket, and are cut off by the rotary knife *131*. After this the stalks are advanced past the first brush *114* against which a presser or spring holds them. Beyond this point, they advance and are forced over against the second brush, where the brushing operation is repeated. In this way the brushes operate effectively to remove the leaves from the cane. The guard bars *122* and *123* operate effectively to present the cane from becoming entangled in the beaters of the brushes. After leaving the second brush *120*, the cane passes toward the rear of the guide frames, and eventually passes out of engagement with the chains, and then falls to the ground or into a wagon for treatment in the cane mill. A channel receives the lower ends of the stalks immediately after they are cut off. This channel supports the lower ends of the stalks in their complete movement through the machine, and assists in guiding the stalks to the brushes. The chains *77* and *94* above also grasp the stalks, and drag the lower ends of the cane up into the channel. Spring arms *80* yieldingly hold the stalks of cane in position as they pass through the machine. In this way the chain *77* which runs over the arms, can move backwardly so as to accommodate unusually large bundles or bunches of the stalks as they advance. Attention is called to the arrangement of the forward end of the double



chain *94*, and especially to the run of the chain between the pulleys *91* and *92*. This run of the chain forms a large angle or V with the forward end of the chain *77*, which operates as a guide so as to bring the stalks into the space between the guide frames. Where the expression "diagonally thereof" is used, it is meant in the sense that the axis of the stalk and the axis of the stripper are inclined to each other at an appreciable angle at the instant of stripping. This causes a much more efficient and uniform stripping action than can be obtained when the stripping brushes are arranged with their axes substantially at right angles to the axes of the stalks. Claim 1 :—In a machine of the character described, in combination, a frame, guide frames forming a space therebetween through which the cane stalks may pass in a standing position, means for advancing cut stalks between said guide frames, a rotatable topping knife, a vertically adjustable carriage carrying said knife and mounted within one of the guide frames, vertically disposed brushes mounted in the guide frames in the rear of said knife, guide bars for guiding the stalks from one brush to another and a guide bar carried by said knife carriage and arranged to guide the stalks in their passage by the knife and from the knife to the first stripping brush in the rear of the knife.

ROTARY DRYER. *Godfrey Engel, Sr.*, (Assignor to *Buffalo Foundry & Machine Co.*, of Buffalo, New York, U.S.A.). *1,453,312*. May 1st, 1923.

Claim 4 :—In apparatus of the character described, a drying cylinder, a furnace for heating the same, an air pre-heater disposed in the path of the furnace gases, a conduit for passing air through the pre-heater and the drying cylinder to the furnace, valve mechanism for controlling such flow of air and including a valve at one end of the pre-heater for controlling flow through one section of or through the entire pre-heater, and a valve at the opposite end of the pre-heater for enforcing flow through another section of the pre-heater or permitting flow direct to the drying cylinder.

COOLING AND STABILIZING CHARCOAL (OR DECOLORIZING CARBON). *Orin F. Stafford*, of Eugene, Oregon, U.S.A. *1,464,732*, August 14th, 1923.

Charcoals or carbons when discharged hot from the retort will quickly take fire if there is sufficient access of air, and in consequence the material has to be cooled rather slowly with the admission of a small amount of air. A process of rapid cooling is disclosed in this specification, according to which the material from the retorts is discharged into a closed receptacle, in which it is agitated while a current of inert gas (carbon dioxide and nitrogen) is passed through, a gas then being gradually substituted containing a substantial proportion of oxygen when the temperature has fallen to about 200° C.

PRODUCTION OF CHARCOAL.[1] *Stanley Hiller and Louis A. Clarke* (assignors to *Pacific By-Products Co.*, of San Jose, Cal., U.S.A.). *1,465,131*. August 14th, 1923.

A method and means are here provided whereby a high grade charcoal may be continuously and rapidly produced, and in a manner to insure that the charcoal will be thoroughly oxidized during its production this oxidization being brought about by the combustion of the gases of the raw material, which burning gases may be utilized as a source of power, all of which operations are continuous. The invention contemplates the use of a burning chamber into which the raw material is delivered and burned by the combustion of its own gases, these gases preferably later passing to a boiler and serving as a heating medium therefor, while the charred product is thereafter thoroughly oxidized, pulverized, and finally supplied to a feed hopper, from which it may be sacked or otherwise shipped.

KILN FOR THE REVIVIFICATION OF DECOLORIZING CARBON.[2] *Abraham Wijnberg*, Amsterdam, Holland. *1,440,194 ; 1,440,195*. December 26th, 1922.

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[1] *Cf.*, U.S. Patent, 1,458,410; *I.S.J.*, 1923, 503.
[2] See also U.K. Patent. 104,456; *I.S.J.*, 1917, 431.

MANUFACTURE OF ETHER. *John P. Foster*, of Paia, T.H. *1,474,772*. November 20th, 1923.

Claim 1.—In an apparatus for the manufacture of ether, the combination of a still having a conduit leading therefrom for the transmission of gases, of a save-all interposed in said conduit to arrest the flow of the gases for the deposition of the entrained liquid particles, and a drain pipe leading from the save-all back to the still to return to the latter the liquid collected in the save-all.

ALCOHOL MOTOR FUEL. *Walter T. Schreiber*, of Baltimore, Md. (assignor to *U.S. Industrial Alcohol Co.*). (A) *1,474,982*. (B) *1,474,983*. November 20th, 1923.

(A) A fuel that has a freezing point below -50°F.; and that comprises alcohol gasoline, benzol, ether, and toluene, the proportion of benzol being approximately 15 per cent. of the mixture. (B) A fuel comprising a petroleum distillate, an alcohol, benzol, and a higher ketone.

CENTRIFUGAL, IN WHICH MOLASSES AND WASH-LIQUOR ARE COLLECTED SEPARATELY. *Eugene Roberts* (assignor to *The Western States Machine Co.*, of Salt Lake City, Utah, U.S.A.). *1,441,752*. January 9th, 1923.

Claim 1.—In a centrifugal machine the combination of a curb or juice collecting casing provided at its bottom with outer and inner collecting troughs having separate outlets, and interior movable partition sub-divided vertically into curved sections or shutters supported to form a circular shield for deflecting the centrifugally expelled juice into the inner trough and being movable outwardly away from said inner trough into position to deflect centrifugally expelled liquid into the outer trough, and means for normally retaining said sections or shutters into their inmost position during the operation of extracting the liquid content from the material that is centrifugally treated, substantially as described.

BEET SLICING MACHINE. *Delphin H. Spicer*, of Cleveland, Ohio, U.S.A. (assignor to *The Dyer Company*, Cleveland, Ohio, U S.A.). *1,474,797*. November 20th, 1923.

Claim 1.—In a beet slicing machine, the combination of an outer casing forming a delivery hopper, a bed plate within said casing, a rotatable driving spindle extending through and above said bed plate, a series of guides secured to said plate and extending vertically, knife boxes slidably mounted in said guides, blind boxes also slidably mounted in said guides below said knife boxes, knives removably secured to said knife boxes, means for adjusting said knife boxes radially to adjustably position said knives to vary the thickness of the slice, a runner mounted on said spindle and rotatable therewith, said runner having open-ended pockets and being adapted to force the beets outwardly against said knives by centrifugal action during rotation to slice the beets.

BEET PULLER. *Oscar A. Thomas*, of Oxnard, Cal., U.S.A. *1,462,948*. July 24th, 1923. BEET TOPPERS. (*A*) *Clarence M. Greening and Charles W. Greening* of Breckenridge, Mich., U.S.A. *1,462,907*. July 24th, 1923. (*B*) *Arlington P. Mortensen*, of Provo, Utah, U.S.A. *1,466,889*. September 4th, 1923. (*C*) *Amos Bailey*, of Uttumwa, Iowa, U.S.A. *1,467,415*. September 11th, 1923. (*D*) *S. L. Pond and G. E. Simkins*, of Hill City, S. Dak., U.S.A. *1,467,650*. September 11th, 1923. (*E*) *Bronislaw Kaezmarski*, of Detroit, Mich., U.S.A. *1,471,738*. October 23rd, 1923. (*F*) *John L. Bynne and Fred V. Seneder*, of Denver, Colo., U.S.A. *1,472,959*. November 6th, 1923. BEET HARVESTERS. (*A*) *Peter J. Boyle*, of Saginaw, Mich., U.S.A. *1,458,615*. June 12th, 1923. (*B*) *John Devey*, of Lehi, Utah, U.S.A. *1,462,486*. July 24th, 1923.

GERMANY.

INVERSION OF SUGAR SOLUTIONS, USING INVERTASE. *G. Bruhns*, of Charlottenburg-Westend, Germany. *376,404.* November 17th, 1920; published, May 26th, 1923.

Claim 1.—Process for the inversion of sugar solutions of all kinds, thereby characterized that sugar solutions having a sucrose content from 40 to 80 per cent. are brought into intimate contact with invertase or substances containing or secreting it (e.g., species of yeast), or are passed or filtered through the latter. Claim 2:—Modification of the process according to Claim 1 therein consisting in effecting inversion simultaneously by means of invertase and small amounts of acid. Claim 3:—For carrying out the processes according to Claims 1 and 2, the use of filter-presses, centrifugals, or apparatus like sand-filters, with or without stirring arrangements, and interior or exterior heating appliances.

DECOLORIZATION OF SUGAR JUICES AND LIQUORS. *Zuckerraffinerie Tangermünde Fr. Meyers Sohn Akt.-Ges.*, of Tangermünde, Germany. *376,411.* June 15th, 1921; published July 18th, 1923.

A process for the decolorization of sugar juices and liquors is described, according to which, during or after the addition of well-known decolorizing materials as animal or vegetable carbons, kieselguhr, wood-meal, and substances acting similarly, atmospheric air is passed through, after which the liquid is separated by filtration in known manner from the solid matter added.

MANUFACTURE OF DECOLORIZING CARBON. *Meister, Lucius & Brüning*, of Hochst a. M., Germany. *371,691.* September 7th, 1920; published March 17th, 1923.

Claim is made for a process for the production of 'highly-active carbon, thereby characterized that carbonaceous substances are mixed with phosphoric acid, or with compounds which on heating and in presence of water decompose into phosphoric acids, and the mixture heated to complete carbonization. According to an example, wood waste is soaked in its weight, or a multiple of its weight of phosphoric acid of sp. 1300, and heated in a current of nitrogen to complete carbonization, after which it is repeatedly extracted with water, and dried at 100° C., when a carbon possessing excellent absorbing and catalytic properties is said to be obtained.

REMOVAL OF AIR FROM MASSECUITES IN THE PRODUCTION OF MOULDED SUGAR. *Carl Schüler*, of Grevenbroich, Germany. *360,762.* July 12th, 1921.

Claim: Process for the removal of the air from sugar massecuites in the production of moulded sugar, especially in the Adant process, thereby characterized that the moulds during or after the introduction of the hot grain massecuite are shaken or agitated.

JAPAN.[1]

FILLING CHAR CISTERNS. *Nagayasu Asai and Dainippon Seito Kabushiki Kaisha. 41,031.* December 9th, 1921.

An inclined tube is inserted into the top of a filtering tank for the supply of bone char. By rotating this tube with a suitable mechanism, an even filling of the tank can be effected.

DECOLORIZING SUGAR JUICES, ETC. *Shinkichi Yamazaki. 41,186.* December 19th, 1921.

Juice, etc., is agitated with about 1 per cent. of calcium hydroxide and the excess of lime precipitated with carbon dioxide or zinc sulphate. The filtrate is slightly acidified with oxalic acid, warmed slightly, filtered, and treated with zinc (4 grms. per 600 grms. of sugar) and oxalic acid at 50-70° C.

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[1] Reproduced from *Chemical Abstracts*, 1923, 17, No. 13, 2371.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
Unrefined Sugars.	1922. Tons	1923. Tons.	1922. Tons.	1923. Tons.
Poland	....	2,340	107	8,252
Germany	....	....	60	2
Netherlands	....	....	475	14
France	....	. ..	....	....
Czecho-Slovakia		....	..	....
Java	475	7,859	158,722	256,564
Philippine Islands	....	....	....	....
Cuba	7	....	634,483	257,435
Dutch Guiana	502	446	3,907	3,571
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	20,081	7,497	105,739	94,386
Brazil	17,514	2,343	108,517	88,351
Mauritius	22,141	44,629	193,293	221,912
British India	....	2,175	2,880	28,238
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	2,011	5,938	96,090	98,372
Other Countries	3,766	18,951	81,156	116,702
Total Raw Sugars	**66,498**	**92,178**	**1,385,431**	**1,174,159**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	7,812	14,669	56,550	81,995
Belgium	10,448	10,455	34,599	34,535
France	645	....	6,614	235
Czecho-Slovakia	19,939	29,704	49,321	111,273
Java	415	1	10,958	10,950
United States of America	2,120	114	265,295	96,140
Canada	1,850	1	82,558	28,606
Other Countries	2,871	1,607	17,643	30,403
Total Refined Sugars	**46,101**	**56,552**	**523,539**	**394,139**
Molasses	23,319	8,768	122,771	132,515
Total Imports	**135,918**	**157,498**	**2,031,741**	**1,700,813**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	196	3	2,332	834
Netherlands	151	77	3,311	2,028
Portugal, Azores and Madeira	....	....	....	....
Channel Islands	37	118	1,020	1,045
Canada	....	....	....	....
Other Countries	408	6,535	22,494	48,395
	792	6,734	29,157	52,303
Foreign & Colonial Sugars.				
Refined and Candy	147	472	5,265	15,330
Unrefined	810	3,721	9,427	25,338
Various Mixed in Bond	....	....	....	....
Molasses	374	178	3,505	3,073
Total Exports	**2,123**	**11,105**	**47,354**	**96,044**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1923. Tons.		1922. Tons.
Total Receipts, January 1st to December 26th	2,859,187	..	3,618,394
Deliveries ,, ,, ...	2,858,393	..	3,618,394
Meltings by Refiners ,, ,, ...	2,828,780	..	3,587,636
Exports of Refined ,, ,, ...	195,000	..	724,500
Importers' Stocks, December 26th	794	..	—
Total Stocks, December 26th	24,146	..	28,836
	1922.		1921.
Total Consumption for twelve months	5,092,758	..	4,107,328

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1921, 1922, AND 1923.

IMPORTS.	1921. Tons.	1922. Tons.	1923. Tons.
Refined......	468,162	523,539	394,139
Raw	814,838	1,385,431	1,174,159
Molasses	94,618	122,771	132,515
	1,377,618	2,031,741	1,700,813

EXPORTS (Foreign).	1921. Tons	1922 Tons.	1923. Tons.
Refined.. ..	801	5,265	15,330
Raw	3,310	9,427	25,338
Molasses	812	3,505	3,073
	4,923	18,197	43,741

HOME CONSUMPTION.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined	469,362	..	498,871	..	378,154
Refined (in Bond) in the United Kingdom	787,572	..	937,579	..	940,057
Raw	131,966	..	168,082	..	152,136
Total of Sugar	1,388,900		1,604,532		1,470,347
Molasses..	10,991	..	10.237	.	10,086
Molasses, manufactured (in Bond) in United Kingdom ..	47,539	..	52,090	..	55,409
	1,447,430		1,666,859		1,535,842

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT DECEMBER 31ST, 1923.

	1921. Tons.		1922. Tons.		1923. Tons.
Refined in Bond	28,350	..	56,000	..	47,150
Foreign Refined	17,650	..	34,600	..	20,100
,, Unrefined..	125,200	..	212,250	..	99,450
	171,200		302,850		166,700

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th December, 1923.

The market throughout the period under review has maintained an extraordinary firmness for actual sugars, although there have been considerable fluctuations in the forward months.

In the terminal market the feature has been the Demceber position ; a very large "bear" account apparently existed and although over 7000 tons were tendered during the last few days the price was driven up from 29s. 6d. to 32s., a large business taking place on the 31st December at this latter price.

Speculative interest still seems to be non-existent and the London quotations have fluctuated more or less in sympathy with the New York futures market. March sold from 28s. up to 29s , May from 27s. to 28s. 9d., the highest point being on December 20th but towards the end of the year—owing to the want of support—prices relapsed and March and May were sold respectively down to 27s. 3d. and 27s. The market afterwards temporarily recovered and March and May sold up to 28s. 6d. and 28s. but subsequently fell away again. A fair business was done in January from 29s. 6d. to 30s. 3d. At the time of going to press the latest prices are: January, 30s.; March, 28s. 3d.; May, 27s. 4½d.; August, 27s. 1½d.

Trade in actual sugars has been confined to spot and ready deliveries, and because of the great scarcity prices have remained firm. The London Refiners have maintained their prices although being rather high in value not much fresh business was transacted and their efforts were devoted to the delivery of existing contracts. On the last day of the year the price of Tate's Cubes was reduced 1s., and on the 7th January all the London Refiners' prices were reduced by 6d , and for February delivery by 1s. To-day's quotations are: No. 1 Cubes, 62s 3d.; London Granulated, 60s. 1½d. Several refiners remain closed in Liverpool and the Clyde owing to want of raw supplies and business in raws was small ; a few parcels of Brazils and Peru 96 per cent. were sold at 26s. 6d. and 26s. c.i.f. for December shipment. During January Perus were sold for prompt shipment at 25s. 9d. The feature has been the fall in the price of new crop Cubans, January has been offered down from 28s. c.i.f. to 25s. 9d., February from 26s. to 24s. 4d., and March from 25s. 6d. to 24s.

Foreign Refined has been in active demand on the spot and for prompt shipment. Spot Javas sold from 57s. 3d. to 57s. 9d. Fine Granulated on the spot sold from 58s. to 59s., and a good business has been done. Czecho Granulated ready sold at 29s. 9d. to 30s. 6d. f.o.b. December from 28s. 9d. to 30s., and January/March from 28s. to 29s. 9d. to 28s. 6d.

Owing to the closing of the Elbe navigation due to severe frost the "ice clause" has been invoked for 15,000 to 20,000 tons of December Czecho Granulated, and this has naturally further accentuated the scarcity of spot sugars. Dutch Granulated has not been freely offered but ready sold from 30s. 9d. to 31s. 9d. A fair business has been done in Belgian Granulated ready from 29s. to 30s. Some offers of American Granulated have been in the market, January at 34s. 9d. c.i.f., and March/April at 31s. 6d., but no business is reported up to the present.

The demand for Refined in America slackened off very considerably over the period of the Christmas holidays. The remainder of the old Cuban crop was sold round about 5½ cents. The premium on the new Cubans has rapidly fallen away from 5½ cents to 4½ cents which is the latest price ruling for Cuban 96 per cent.

Mr. Himely has estimated the coming Cuban crop at 3,813,000 tons, and an estimate has also come to hand from Messrs. Guma and Meyer who put the crop at 3,750,285 tons.

With regard to the European Beet crops Mr. F. O. Licht has issued a further revised Beet estimate showing a reduction in figures:—

Germany	1,125,000 tons.	Denmark	114,000 tons.
Czecho Slovakia ..	1,030,000 ,,	Sweden	151,000 ,,
Austria	40,000 ,,	Poland..	405,000 ,,
Hungary..	125,000 ,,	Italy..	325,000 ,,
France..	475,000 ,,	Russia..	300,000 ,,
Belgium	300,000 ,,	Spain	190,000 ,,
Holland	230,000 ,,	Other countries	170,000 ,,
			4,980,000 ,,

It is reported that the German Government have granted permission for the export of 80,000 to 100,000 tons, and in fact some 10,000 to 15,000 tons have already been sold to neutral countries, and also India.

21, Mincing Lane,
London, E.C. 3.
January 11th, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 302. FEBRUARY, 1924. Vol. XXVI.

Notes and Comments.

The Political Situation at Home.

Since we commented upon the political situation last month, Mr. Baldwin's Government has been defeated, and by a majority of 72. Mr. Ramsay MacDonald, Leader of the Labour Party, has assumed office, so that in the plain words of *The Times* we have in power "a new party in the State—a party which frankly professes the doctrines of Socialism." The new Premier has completed his task, admittedly a difficult one, of forming his Ministry; and now, with Mr. MacDonald himself as Foreign Secretary, we have Mr. Philip Snowden as Chancellor of the Exchequer; Mr. J. H. Thomas as Colonial Secretary; Mr. Sidney Webb as President of the Board of Trade; and Mr. Arthur Henderson as Home Secretary. In regard to other Ministerial positions, these have also been filled (with perhaps two exceptions) from the more moderate element of the Labour Party; while two incongruous appointments are noteworthy, namely Viscount Chelmsford (a life-long Conservative) as First Lord of the Admiralty, and Lord Parmoor (also a Conservative) as Lord President of the Council. It now remains to be seen what Mr. MacDonald's party will do now that it is in occupation of the Treasury Bench. But whatever measures it may put forward, there will remain the comforting reflection that the Socialist Party is in a considerable minority; and that it is liable to defeat by the other two parties if at any time legislation of a dubious nature is attempted.

The Position of the Conference Decisions.

In the King's Speech at the opening of Parliament, reference was made to the decisions of the Imperial Conference held in London a few months ago, these being described as having "marked a very definite progress in Imperial co-operation." It was further said that "more particularly was it found possible, without departure from the existing fiscal system in this country, to meet the wishes of the Dominions by a substantial extension of the principle of Imperial Preference established by the Conference of 1917 and in force since 1919." In moving the Address, Mr. R. M. Banks, K.C., Member for Swindon, said that, while he was aware that the resolutions of the Conference cannot become effective until they have been approved and ratified by Parliament, they have expressed "certain opinions and certain wishes with which His Majesty's Ministers concurred; and deliberately to flout those opinions would . . . . . . be little short of a national breach of faith." When replying to these remarks, Mr. MACDONALD disclaimed with some spirit the principle that Parliament is under any obligation to accept any decisions arrived at by the Imperial Conference, though later in the same speech he admitted that he and his Party recognized that "every pledge given by Ministers at the Imperial Conference, economic and otherwise, that matters shall be brought before the House, shall be fulfilled to the last letter, and the fullest extent." So there rests for the time being the fate of what Mr. MASSEY has termed "the agreements arrived at by the Empire in Council."

British Beet Contracts.

Considerable publicity has been given in the press to an agitation which was commenced by the National Farmers' Union before the beet contracts for the present year had been offered by the factory companies, and the position that arose caused concern to those who had begun to take a more rosy view of the development of the beet sugar industry in this country. The farmers' demands were instigated by the fear of a reduction of the duty and also a reduction of the market price of sugar this autumn. Last year's contract for the supply of beets to Cantley and Kelham was on a sliding scale, varying according to the average sale price of sugar and also according to the sucrose content of the roots delivered. If, for instance, the average selling price of sugar was 59s. per cwt., then the price of the beets per ton delivered was 59s. plus or minus 2s. 6d. per ton for each 1 per cent. of sugar content above or below 15·5 per cent. It was argued by the Farmers' Union that if the duty was reduced 1d. per lb., and the market price also fell 1d., this would mean a reduction in the price of sugar of approximately 20s., thus lowering the price of the beets to less than 40s. per ton. On the other hand, the Cantley factory had made a net profit of about £103,000 (not £135,000, as previously reported); and, although this surplus had to be applied to the accumulated deficiencies of previous campaigns, the Union held that the profit retained formed too great a proportion of the advantage resulting from the remission of the Excise Duty. A conference between the farmers and the Cantley directors took place, and the result of these negotiations is one which reflects great credit and foresight on the part of both parties concerned, and constitutes the first real step towards effecting the stability of the industry. It was agreed that, while the one-year contracts already offered should stand, and should form the basis of the commercial relations between the two interests, every grower should be offered the option of a three-year's contract. A grower agreeing to deliver beet for three years should have an increased price, this being fixed as an additional one-seventh of the average selling price of the sugar. For example, if the selling price of the sugar is 49s. per cwt., the addition to the basic price for beets will be 7s. per ton, so that the grower would receive in all 56s. per ton for roots of 15·5 per cent. content delivered at the factory. It is understood that a very large proportion of the growers for the Cantley factory will have received this year upwards of £30 per acre for their 1923 supplies, the cost being estimated at £16. In regard to the sugar content, this has remained at a high figure (averaging about 16 per cent.) though the weather conditions of last year lowered somewhat the average yield.

The Indian Sugar Industry.

The Indian Sugar Bureau, abstracts from whose annual report we print elsewhere in this number, appears to be doing very useful work. Not only is it submitting the new seedlings produced at the Coimbatore Cane-breeding Station to such tests as have not been possible with any previous varieties in India, but it is in close touch with the various sugar interests in a quite exceptional manner for a Government Department in that country. The recommendation of the Inchcape Committee, whose main object was to cut down all unnecessary expense in the machinery of government, after reviewing the record of work of the Bureau, was that "the necessity of its retention should be examined." It is somewhat surprising to read also that this useful "service" is only on a temporary footing, with all the inherent disadvantages of such a position; and therefore that the Government has resolved that the Bureau shall be further extended to March, 1924. But the Secretary, Mr. **Wynne Sayer**, does not appear to be daunted by these threats of early dissolution, for he obviously has the whole trade behind his back. They have, in fact, provided more funds than the Government have for the work that he is doing, and there is little doubt that his optimism is well founded, not only because of this solid demand on the part of the trade, but also because of the great interest evinced in the Department by the unofficial members of the Legislative Assembly.

There appears to be no doubt that the Indian sugar industry is turning a corner and that a period of expansion has commenced. But this must not be taken to mean that the progress will as yet be very rapid. In the past, as we have again and again pointed out, a great deal of effort and money has been wasted in launching unconsidered schemes for sugar production in the country, and we therefore welcome the caution everywhere displayed. But there are signs that the happy-go-lucky policy of the past, chastened by a series of set-backs, is no longer likely to continue; and the most satisfactory reason for coming to this conclusion is that the Bureau is keeping itself well informed on all points likely to be limiting factors in the success of new ventures, and freely distributing this information to all who take the trouble to ask for it. Further, and this is by no means a small matter, the trade has, in Mr. **Noël Deerr**, the best advice which can be obtained on all technical matters in the factories. Although lamentable misjudgments have in the past been made on plantation estimates, it is chiefly due to the locking up of the money in inappropriate and inefficient factories that ruin has overtaken those who have ventured to launch on this troubled sea. Progress will be slow at first, for there are very many difficulties still in the way, but, when once the corner has been successfully turned, we think that it will be cumulative and more rapid. It is however idle at the present juncture to suggest the limits of such expansion, at any rate till the difficulties ahead have been properly studied and correctly gauged. With good new canes, expert advice at hand, full information available for the asking, and a high protective tariff, the prospects are certainly more reassuring than they have ever been in the past.

Recovery of the Sugar Industry in France.

Not a little attention is being given by cane sugar producing interests to the situation in France in regard to the rate of recovery of the beet industry there. A few pertinent data were recently contributed to the question to MM. **Lindet** and **Naudet** in a paper read before the Société d'Encouragement pour l'Industrie Nationale, giving a general survey of the situation, from which it can be gathered that good progress towards recovery has so far been made. Of the 214 factories possessed by France before the war, 148 representing a working capacity of

67,970 tons of roots in 24 hours were destroyed; and, as the pre-war capacity was about 100,000 tons in 24 hours, this means that about two-thirds of the production was annihilated by the Germans. So far a capacity of about 41,640 tons in 24 hours has been retrieved, that is about 60 per cent. of that lost in the war. In general, these new factories are much larger than before. Whereas formerly the 41,640 tons were sliced in 110 factories, now they are worked up only in 51, that is, a present slicing capacity in 24 hours of 800-900 tons in place of one of only about 460. It is of some interest to note how the new factories have been distributed in the different *départements*, or provinces. Thus, the Nord leads with 16 factories having an average slicing capacity of 820 tons; the Aisne follows with the same number of factories, but these have a lower capacity, viz., 609 tons; the Somme has six with 1415 tons; Ardennes and l'Oise each have three of 588 and 560 tons; while Pas de Calais, where formerly beet cultivation was considerable, has three factories averaging 1200 tons, which statement is deceptive, as two of them are only slicing establisments or *raperies*.

At the present time the position is that one-half of the two-thirds of the production destroyed has been rebuilt, leaving yet one-third to be regained, and the important point is how soon France will be able to do this, in order to make it unnecessary for her to import Cuban raw sugar. It is not possible to give any definite answer to this question, but these writers appear to consider that it may not be long before the desired recovery is achieved. They advocate the construction of factories elsewhere than in the Nord department, "which is already sufficiently equipped." Other departments, more remote from the coal fields grow good roots, such as the Seine-Inférieure, the Eure, the Eure-et-Loir, Haute-Marne, Puy-de-Dôme, and Vaucluse; and anyway the justification for locating factories in the Nord near the coalfields has not the same value now-a-days, since instead of burning 120-130 kg. of coal per ton of beets, a modern sugar factory should burn only 70. Altogether, the situation in regard to recovering pre-war production in France is considered hopeful by these writers.

Progress of the Petree Process.

We remarked recently that few, if any, of the important innovations which have been offered to the sugar industry have made such rapid progress in the initial years following their introduction as has the Petree Process of obviating the use of filter-presses in clarification. A good number of licences to operate it have now been taken out in most cane-growing countries, and there appears no reason to doubt that this early success will at least be maintained. A few months ago Mr. PETREE completed a tour of estates in Natal and Zululand, and his visit resulted in three large factories placing orders for the process including Dorr clarifier equipment. This means that to date licences have been granted to seven factories in South Africa, from which it is evident that purchasers in that country, as elsewhere, are convinced that the process is not an experimental one, and that the claim made for "more sugar at less cost" can be realized in practice. Mr. J. P. FOSTER, of the Paia Mill, T.H., stated recently[1] that, after having "lived with the process during the past season," he would not willingly return to the mud press system; that the sugar made while the installation was operating had apparently improved in quality; and that he believed the over-all recovery had increased in spite of a drop in extraction (which he hoped to correct next crop).

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[1] Paper presented to the Committee on Manufacture of Sugar, Hawaiian Sugar Planters Association, for the year ending September 30th, 1923.

Further, that the cost of manufacture was reduced by eliminating 14 men and women from the mill pay-roll; by obviating expenditure on filter-cloth used formerly; by the removal of a very large amount of piping and several pumps; by putting the clarified juice into the evaporator at a temperature about 20° F. higher than before; and by a reduction of over 30 per cent. in low-grade boiling and machine work. Summing up his discussion regarding the Petree Process, this technologist concluded that, after considering all the factors known in regard to its operation, he believes that "it pays."

Determination of the Actual Sucrose Content.

It is trite to remark that there is no more important task with which the sugar chemist is confronted than the determination of the true sucrose content of factory and refinery products. This determination is the basis of his work as accountant of the sugar entering into operation in the raw material and leaving in the finished and waste products; and any attempt to introduce refinements in chemical control are of little value unless the sufficient accuracy of the sucrose assay be assured. A great amount of research has been done in this direction, the method almost universally adopted on account of the comparative ease and rapidity with which it may be performed being that known as double polarization. On the whole, the results of this research have been satisfactory, causes of error having been located, and means of avoiding them having been proposed. But those who have followed the general trend of these investigations will agree that, although certain of the modifications of the double polarization method recently proposed probably give very reliable results, something more has yet to be done in the way of simplification, so as to evolve a *modus operandi* more suitable for rapid routine operation. It is probably for the reason suggested that the modifications recently proposed by JACKSON and GILLIS,[1] of the Bureau of Standards, Washington, in their very thorough work on the subject, have not been applied in factory control.

At the present time, the Herzfeld method, or some modification of it not differing essentially in principle, is still generally in use. Yet, especially in the case of impure products like molasses, the work of several investigators seems to indicate that this method may be inexact to an extent by no means inappreciable. Whether that is actually so has yet to be definitely established by numerous careful tests. In brief, the position is that in the Herzfeld method a certain error may arise from the fact that the direct reading is taken with a solution that is weakly alkaline (owing to the presence in it of basic lead acetate) and the inversion reading with one that is distinctly acid (as it still contains the hydrochloric acid used for hydrolyzing the sucrose), under which conditions the change of rotation is not due solely to hydrolyzed sucrose, as theoretically should be the case, but also to the rotation of certain optically-active impurities not being the same in the alkaline and in the acid solutions, results thus being vitiated. Jackson and Gillis' modifications were devized for the purpose mainly of overcoming this source of error (though they considered others as well, which need not be mentioned here). Thorough comparative determinations, therefore, require to be carried out in order to ascertain precisely the extent of the suspected error, and it is certain that this is a subject that should have the consideration of chemists in different countries. A start in this direction has been made by Mr. MANUEL L. ROXAS,[2] of Manila, P.I., who has carried out a series of experiments, operating evidently with every precaution, and has stated figures which are each the average of 30 determinations. His results emphasize the desirability, or rather the necessity, of further attention being given to the problem of the precise determination of sucrose in juices, massecuites, molasses, and the like.

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[1] *I.S.J.*, 1920, 509, 570, 638.

[2] *Reports of the First Annual Convention of the Philippine Sugar Association, Manila*, 1923 pages 137-141.

Now the question is whether really there is much difference between the results given by the new method (from which known sources of error have been eliminated) and the Herzfeld process, at present largely used; and the answer to be read from the figures tabulated by Mr. ROXAS is that in some cases the difference is actually a serious one. In the case of a mill juice, he obtained sucrose and gravity purity values of 13·04 and 86·93 by the Jackson and Gillis method, but 14·09 and 93·93 were the results by Herzfeld's process; while with a first molasses the figures were 41·15 and 58·79 on the one hand, and 39·10 and 55·86 on the other.

These figures (and others which were presented by this investigator) would appear to show that the results given by Herzfeld's method, now almost generally used (at any rate for molasses), may be inexact, and indeed to no small extent. Therefore, it certainly seems expedient that further systematic work should be done by chemists, preferably working in collaboration, in order to establish the exact position of the question of the determination of sucrose in factory and refinery products. It would be of some value at the same time to compare the results obtained by double polarization modifications with those given by a standard gravimetric method, and by the Lane and Eynon volumetric process,[1] making allowance for non-sugar reducing substances. Work on these lines should yield definite information on what is admittedly an important question concerning chemical control in the sugar industry.

Statistics of the Indian Sugar Market.

The position of the sugar industry in India is rapidly engaging the attention of other countries, and it is considered by Mr. WYNNE SAYER[2] that it is high time that she realises this and, with it, her own possibilities. The gur and white sugar industries are however largely independent, affecting, as they do, entirely different classes of the community. During 1922-3 the production of gur was 2,875,300 tons, representing an increase of over 300,000 tons over the previous year, which was 100,000 tons beyond the one before, 1920-1. Presumably these differences were the result of improved agricultural conditions in the country. The production of sugar from modern factories during the year was 77,628 tons with an increase of 4500 tons, but against this must be set a decrease from 50,000 to 40,000 tons in the amount produced by indigenous methods. We thus reach a total production of 117,600 tons of sugar in India, showing a slight fall on that of the previous year.

The importation of sugar (chiefly from Java) meantime fell from 628,000 tons to 373,000. This was obviously not due to any increase in the local output, but is traced in the Review to heavy losses experienced by the merchants in 1921-2 and a substantial carry-over from that year, together with the knowledge that Cuba had a surplus to the extent of 1,250,000 tons of sugar. The increase in the import duty on sugar from 15 per cent. *ad valorem* to 25 per cent. had not time to have much effect; anyhow, it was largely discounted by the prevailing low price of sugar at the time. It is also considered that, indirectly, the great increase in the quantity of gur produced may have had some effect in the same direction. All of this, together with a shyness based on past experience, of capital from abroad entering the industry, adds additional weight to our observations made above on the slowness of reaction in this great country to the rapidly improving prospects of founding a great white sugar industry.

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[1] *I.S.J.*, 1923, 143.

[2] A Review of the sugar trade in India for the official year, 1st of April, 1922, to 31st March, 1923. WYNNE SAYER, Secretary, Sugar Bureau.

India, however, as Mr. **WYNNE SAYER** remarks, is no longer an isolated country, unaffected by trade fluctuations in other parts of the world, and is beginning to take note of the changes in prices in the world's markets, and, what is more, to comprehend the reasons for these changes. This he demonstrates by a Table in which he compares, month by month, the price of a representative grade of local white sugar with that of Java, for the eastern markets, and of Cuba for the western. "India has already paid heavily for ignorance in this respect, and a policy of lofty indifference to and ignorance of world factors will spell disaster in the future, even more than in the past." One noteworthy feature emerges from this study, namely the rise of over 100 per cent. in the price of Cuban sugar at the end as compared with the beginning of the year, with, in the same time, a clearance of over a million tons of accumulated stock in that country. In sympathy with this the Calcutta prices per maund of Java sugar, which fluctuated during the year between Rs. 14 and Rs. 16, rose in March to about Rs. 20. In Bombay the figures were Rs. 21 to Rs. 24 with a rise in March to Rs. 29; and in Karachi the minimum for the year was Rs. 19·9·0 and the maximum Rs. 27·5·0.

It is pointed out that the figures for production and consumption allow of an ample margin for the making of white sugar in India, and the great problem is how this may be taken advantage of in the industry. The crux of the matter lies in the raw material, namely the quantity and quality of the canes grown in the field, which are inadequate. With the immediate prospect that this want will be remedied, it would appear that the situation is extremely promising; but only by the steady application of the best brains, both in the work of the factory and in the plantations, will the flow of capital commence and the undoubted resources of the country thus be rendered available. And one of the most satisfactory recent developments to this end is the wide publicity campaign which the Secretary of the Sugar Bureau has entered upon.

Ruckstuhl juice settling tanks,[1] the trial of which at Raceland factory, La., has proved "highly successful," are now being installed in the Ingenio Consuelo, San Domingo.

We welcome the appearance of the first issue of *Tropical Agriculture*, the official journal of the Imperial College of Tropical Agriculture, Trinidad. Its *raison d'être* is "to disclose in broad yet exact terms understandable by all classes of readers what tropical agriculture really means, the latest discoveries of research, the many problems that await scientific solutions," and in time "to become a connecting link between country and country by indicating one another's progress or difficulties." Sir **FRANCIS WATTS** writes on "Aims and Work"; Prof. S. C. **HARLAND** on "Research on Tropical Crops"; Prof. N. A. **BALLOU** on "Tropical Entomology"; and Prof. W. R. **DUNLOP** on "Trinidad Cacao." This new contemporary has our best wishes for its success, and the editing of its first number certainly augurs well for the future.

A Conference, attended by the representatives of the principal professional engineering and chemical institutions, the Federation of British Industries, and of the Chartered Institute of Patent Agents, was recently held at the Institution of Civil Engineers; and a resolution was passed to the effect that the powers of the Patent Office should be confined to making a search for novelty through prior specifications (as at present), and should not extend to deciding questions of subject matter. One of the speakers at the meeting explained that some examiners in the Patent Office appear to claim that they have the right to decide whether or not an alleged invention contains good subject matter, or involves sufficient inventive ingenuity to support a good patent. He strongly held that the duty of the examiners should be confined to the question of deciding whether the application relates to a manner of new manufacture.

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[1] *I.S.J.*, 1923, 502, 656.

Fifty Years Ago.

From the "Sugar Cane," February, 1874.

In an article entitled "Notes on the History of Sugar," H. A. SMITH commented on the antiquity of sugar by saying that "it would be difficult, if not absolutely impossible, to name the time when sugar first became known. The sweetness-giver of old was honey, but at least four centuries before Christ sugar was a recognized article, certainly very rare, yet still known . . . . . Many have denied that it was known at all to the Greeks and Romans, but this assertion goes for nothing, as Pliny takes notice of it as coming from Arabia and India . . . In times later than those of Pliny, we find sugar to have come at last to be more than merely used as medicine, but to be required in such quantities that a refinery is at work . . . . ." A description of this old manner of "refining" was given by BARTHOLOMÄUS ANGLICUS in his "De Rerum Proprietatibus," and consisted in pounding up the canes, boiling the juice over a low fire, separating the scum, and placing the sugar in round vessels to dry in the sun.

There was an anonymous article on sugar machinery, originally published in *Iron*, mention being made of Fryer's "affusor," which was described as "a series of rollers within a tank, set in an upper and lower row, all the points of contact being under water except the last one or two, the crushed cane being passed through in one direction, and the stream of warm water in the opposite, carrying with it the bulk of the remaining saccharine matter in solution." This apparatus for maceration had been protected by its inventor[1] and appears to have been used to some extent. The article also described Fryer's concretor, while it further remarked that "for high-class sugar there is nothing comparable to the vacuum pan, wherein the boiling of the syrup at low temperatures enables the concentration to be made with very little deterioration, and the process to be prolonged sufficiently for the generation of large crystals of good colour and composition."

Dr. W. ANDERSON SMITH, in a "Chat about Sugar" drew attention to the marked increase obtaining at that time in the consumption of this product, and said that "such a great and rapid demand cannot have arisen without some real necessity of the human body being supplied, and sugar does supply such a necessity. It is the readiest, and one of the cheapest and most effective modes of introducing heat-givers into the system, prepared for its immediate absorption, and saving unnecessary force in its acidification . . . . ."

Allusion was made in a note headed "Adulterated Syrups" to the practice then prevailing of mixing in comparatively large proportions of starch glucose with cane syrups for sale under alluring names for table consumption, some of the remarks made being as follows: "We buy cane sugar, but we get grape sugar . . . . . This is certainly a fraud, inasmuch as grape sugar has not, weight for weight, so much sweetness as cane sugar . . . . Starch or grape sugar is not necessarily unhealthy or unclean, but it is certainly here used as an adulterant . . . . . Our refiners owe it to their high standing, not simply to disavow any connexion with such disreputable practices, but to institute enquiries, and publish the results in such a manner as will effectually disabuse the public mind upon the subject . . . ."

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[1] **English Patent 1073 of 1869, also several subsequent patents taken out in the name of FRYER.**

Progress in the Sugar Industry in India.[1]

The Sugar Bureau was continued on a temporary footing during the year, but sanction has been obtained for its extension up to March, 1924. The Inchcape Commission reviewed its work and recommended that the necessity of retaining it should be examined. The work done by it for the improvement of the sugar industry during the past four years has, however, been so substantial that the Indian Sugar Producers' Association, whose headquarters are at Cawnpore, and which represents 90 per cent. of the white sugar industry in India, at once addressed the Government and requested that the Bureau should be placed on a permanent footing. For the expansion of its work the Association expressed its readiness, during the financial stringency, to contribute by means of a cess on sugar produced in India. The large sugar growers in Bihar have expressed their agreement regarding the utility of the work; therefore, it is probable that the Bureau will be retained. During the year the Government voted Rs. 37,290 (about £2500), and the funds received from the public amounted to a little more. It is thus evident that this service is proving useful to various sections of the sugar industry, and that the latter is perfectly willing to pay for it.

1. *Agricultural.*—As mentioned in the last report,[2] from a number of Coimbature cane seedlings, four were selected for trials on a field scale, namely, Co 210, 213, 214 and 221, and planted out. Grown without irrigation, they were free from any serious mycological disease and unaffected by any insect pest, and grew on to an absolutely first-class crop in every way, giving a record yield of 600 maunds (82·28 lbs.) of stripped canes per acre of Co 214, 700 maunds of Co 210 and 800 of Co 213, the average yield of the standard local cane being about 300 maunds per acre. The agricultural side of this experiment thus proved to be a complete success. But mill tests were also necessary before the canes could be recommended for cultivation, as laboratory trials with a small mill usually give much higher analytical results than those obtained in the factory where many disturbing factors are met with. The necessary money was advanced by the industry, so that it was possible to test a certain portion of the crop which had been grown. The first test was 2444 maunds of Co 214 on the 6th December, 1922, at a time when the local canes were very immature; this was followed by 2000 maunds of Co 210 on the 18th December, and 2500 maunds of Co 213 on December 27th. The successful results of these trials were recounted in the *Agricultural Journal of India*[3]; not only were the yields more than double that of the local variety, but the seedlings ripened much earlier, the standard cane only becoming mature in the middle of January.

As soon as the results of these mill trials became known, a great demand arose for seed, and it was possible to supply 76,000 lbs. of it throughout the white sugar tract. But this supply did not meet the demand, therefore 60 acres were put down for the following sowing season, namely, in February, 1924, the funds being supplied this time by the planters themselves. Parcels of these seedlings have also been distributed to the West Indies and Mauritius, as well as to other parts of India. Co 221, the fourth seedling of those mentioned above, was only planted on 1¾ acres, and it was found that, when planted in February, it was easily blown over by the wind; because of its rind it was attacked by jackals, and it suffered to a certain extent from red rot. Its parentage was J 213 × M 2, the latter a prolific Coimbatore seedling of little value from the juice point of view. It was found, however, that, when Co 221 was planted in July and early August and left till the following April, none of these bad characters appeared, and the juice obtained was wonderfully good, Brix being 19·17 per cent., sucrose 17·93 per cent., glucose 0·65 per cent., and purity 93·54. This experiment indicates that it may be possible to plant cane for late crushing, as well as before the standard cane has ripened, thus extending the milling season yet further, at the other end.

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[1] Report of the Secretary, Sugar Bureau, 1922-23. Reprinted from Scientific Reports of the Agricultural Research Institute, Pusa, 1922-23.

[2] *I.S.J.*, 1923, 12-13.

[3] *I.S.J.*, 1923, 354-358.

Two early seedlings, Co 231 and Co 232, both raised by crossing J 213 with Katha, have also been planted on a field scale. Thus far Co 232, having shown itself to be the better of the two in germination, vigour and uniform growth, gives every promise of a heavy tonnage. Mill trials have been arranged for December, 1923, and if these prove satisfactory it is proposed to substitute this seedling for Co 214, which has developed a rather troublesome habit in the field which makes it difficult to cut, transport, and handle at the mill.

As Co 214, Co 213, Co 210 and Co 221 showed such marked vitality, an experiment was started in ratooning them (this practice not being usual in India); and the results so far have been quite satisfactory. If they show a capacity for ratooning, this will practically sound the death knell of the local cane over large estates. A considerable number of fresh Coimbatore seedlings have recently arrived, and of these, nine have been provisionally selected as the most promising.

2. *Industrial.*—The Bureau continues to keep in touch with the sugar factories in India. The first sugar factory in the Bombay Presidency, that in the Nira Valley, was opened during the year, and another is expected to begin working during 1924. A factory is being started for making white sugar from palm jaggery in the extreme south of the Madras Presidency, and another is projected in Travancore. But the greatest development is in the Bihar and United Provinces tract where the prospects are favourable. A factory has been erected at Kachrukhi, and a former gur refinery is adding plant for making white sugar; against this however two concerns have closed down. Meanwhile, it is most encouraging that Messrs. Begg Sutherland & Co., who have greatly helped in the financing of the Sugar Bureau, and who have control of seven factories in Bihar, have enlisted the services of Mr. NOËL DEERR, as chief chemist and technologist. Much is hoped from this efficient scientific supervision as an object lesson to other factories in the tract.

The Bureau has kept in touch with sugar manufacturers in England and the United States of America. The small four-roller power driven mill sent over by the Honolulu Iron Works was forwarded to Dacca for trial, and it is expected that this trial will be made during 1924 with White Tanna and Co 213. After this it will be seen whether the mill can be recommended to cultivators. The exchange for the benefit of persons seeking employment in the industry, which was recently opened, has been active, and applications have been received not only from India but from various sugar making countries of the world. The Bureau thus serves as a useful link between employers and those seeking employment.

3. *Commercial.*—Seventy notes on statistical matters bearing on the production and consumption of sugar in the chief sugar countries of the world, together with the rise and fall in prices, have been issued during the year for the benefit of the trade. The sugar cable series, started in January, 1922, was continued throughout the year and those interested in sugar matters throughout India have joined it as members. It is entirely self-supporting, and has proved of the greatest value in stabilizing the sugar market in India, by preventing any sudden rises and falls due to rumours or unofficial reports emanating from foreign countries.

C. A. B.

Soil and Manurial Studies in Hawaii.

Taking the tropics as a whole, there is a general deficiency of organic matter in soils which have been cultivated for a long time. Consequently, in arranging manurial mixtures for sugar cane, the addition of nitrogen in some form or other assumes a predominant position. Phosphates and potash, on the other hand, are usually present in sufficient quantities for healthy plant growth, but variations occur as to the relative abundance of these two essential plant foods. In Egypt, Java, and, to a less extent in India, neither of these substances is of great importance in the manurial requirements of the sugar cane, although in certain places in the latter country phosphates would appear almost to become a limiting factor. This is also the case, for instance, in upland regions of Porto Rico and Hawaii, while in Jamaica phosphates are definitely ruled out in the manurial experiments, because long experience has shown that no response is shown when they are added. Of the two, potash appears to be less frequently deficient, although in certain cases the addition of this constituent has given marked results. There are thus considerable variations in the amounts of available phosphates and potash in the soil in different tropical countries; and it is thus unsound to rely on the results of experiments obtained in any one locality even for others lying in quite close contiguity.

When, on the other hand, we desire to draw inferences for the tropics from the advanced soil work in countries with a temperate climate, we at once meet with more fundamental difficulties, caused in the main by the nature of the environment. We find that the quantities of available plant food indicating fertility are often very much less in the tropics. This is doubtless due to an increase in chemical and biological action with the rise of temperature, especially accompanied as it often is by a great amount of moisture. The disintegration of the soil and the tapping of the resources of plant food stored in the organic matter and the rocky particles proceed at a much more rapid rate in the tropics, and the withdrawals of plant food by a crop can be much more rapidly made good. Comparatively fertile soils in the tropics when their amount of available plant food has been estimated would very often fall into the class of "poor, worn-out soils" in temperate regions. The turnover in the soil is more rapid, and a smaller working capital is therefore needed for successful planting operations. This will be abundantly evident later on, when we consider the percentages of potash and phosphoric acid in Hawaiian soils.

But this low proportion of available salts has its dangers. The chief of these is the dominant position of nitrogen in the manurial mixtures. The addition of large quantities of this food constituent causes great plant growth, with corresponding great demands upon the soil: demands beyond the limits of the small quantities of available mineral foods. Excessive nitrogen manuring may thus render the soil infertile. Hence the use of the complete manures, even when the soil is provided with sufficient potash and phosphorus for normal healthy growth. Bearing these considerations in mind, the recent intensive work in the Hawaiian Islands on soil analysis and the changes which take place on the additions of fertilizers becomes of absorbing interest to all growers of the sugar cane. We have lately received a report[1] of the progress of investigations carried out in that country during the past year, and some of the details are here recorded.

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[1] Report on Soils and Fertilizers. W. T. McGeorge. Bound up with a series of Papers presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.

The writer of the report commences by pointing out that, in the diversified agriculture of the mainland of North America, all attempts at discovering definite relations between chemical analyses and soil fertility have failed to materialise. But he considers that this failure should not be taken too seriously in Hawaiian sugar cane cultivation, since, where only one crop is grown, the case is somewhat different and is not so hopeless. Such a relation is of very great importance in the islands, because of the very large applications of artificial manures which have become a characteristic of the plantations there. For the collection of data, an intensive programme of soil analysis is being carried on, and the additions during the year both in these and other soil and manurial studies have added important contributions to the solution of many of the outstanding problems.

Nitrogen.—The chief factor in the very great yields of sugar per acre in Hawaii is the heavy applications of nitrate of soda. Assuming that certain plants are able to take in ammonia without the intervention of nitrification (as in rice which the author states can grow to maturity without any nitrate), and considering the low nitrification taking place in the prevailing acid soils, the experiment was tried of growing two one-bud sets in sand and water culture supplied with nitrate of soda and ammonium sulphate respectively. As might be expected, ammonium sulphate induced practically no growth at all; such root eyes as attempted to push out were of a dark colour and entirely free from root hairs. On the other hand normal root and shoot development took place in the set supplied with nitrate of soda. Both plants were under experiments for four months.

A second experiment was based on the heavy nitrogenous manuring in vogue: it was attempted to determine the limits within which such manures might be applied without injury to sugar cane plants. Uniform stools of H 109, obtained by being grown in small seed boxes from single eye sets, were planted in large concrete pots. In one series nitrate of soda was added in amounts varying from 25 to 200 lbs. of nitrogen per acre; in another ammonium sulphate was similarly added in amounts from 50 to 200 lbs., while two pots were used as controls. Altogether the amounts mentioned were given once a month for a year, the first manuring taking place when the plants had been one month in pots and the rest at monthly intervals till the stools had been planted out twelve months, that is, there were eleven applications. At the end of this drastic treatment, the stools were still strong and healthy, although in the case of the heavier applications the plants at times showed signs of injury immediately after manuring. The drainage water was analysed and showed that the great bulk of the salts were retained by the plants, the largest losses only reaching 10 to 20 per cent. of the manure added. There is thus "little danger of injuring the growth of the cane plants by any application of nitrate of soda likely to be made under field conditions."

In last year's lysimeter experiments, sulphate of ammonia was found to be perfectly retained by the soil until nitrification, the ammonia only being found in the first foot of soil. Nitrate was washed to the second and third foot, and under heavy irrigation even to the fourth. Sodium and ammonium nitrates showed a slightly alkaline reaction in the soil, and (as usual) ammonium sulphate a slightly acid reaction. Two series of experiments were made this year, and it was found that, under field conditions, there was better retention of the nitrates than in the lysimeter tests, most of the nitrate of soda being retained in the first two feet. The tests were on three typical Ewa soils, nitrate of soda being added at the rate of 100 lbs. of nitrogen per acre, each year. The first season's application was absorbed in about ten weeks and in the second season in three months. With some soils there was a slight increase in alkalinity; but, as in the lysimeter tests, this gradually disappeared. Somewhat similar results were obtained when mixed fertilizers were applied. This change in the reaction on the soil is considered to be due to the large colloidal content of the soils with a corresponding low percentage of silica.

Studies in organic carbon showed remarkable variations in content of different soils, the quantity being greatest in the humid districts of Hawaii island and lowest in the dry sections of Oahu and Maui. On the whole, when compared with that of mainland soils, the content was not regarded as too low, although these are not strictly comparable. The question to be determined was whether the current practice in the Hawaiian islands was depleting the organic carbon of plantation soils. For answering this question, 42 samples of Ewa soils, representing cultivated and uncultivated portions of nine fields, were analysed as to total carbon content (little or no carbonate carbon being present except in coral soils). In these fields the organic content in four was lower, and in five higher, in the cultivated than in the uncultivated portions of the fields. The variations were, for cultivated fields, from 0·85 to 1·93 per cent. with an average of 1·30, and, for the uncultivated, from 0·74 to 2·60 with an average of 1·37. In these fields the trash is always burnt, and there appears to be no indication that there is any depletion of the organic carbon content, the roots and stubble presumably being sufficient for keeping it up.

This, it seems to the writer of this article, is a remarkable contribution to the much debated question as to the advisability of burning the cane trash or digging it in under Hawaiian conditions. Former experiments have shown little or no advantage from burying the cane trash in Hawaii, and this appears to be in agreement with the general opinion of the planters. It has been suggested that this lack of response may be due, as in the mainland, to the unrotted nature of this substance, in contradistinction to the opinion in other parts of the tropics where, under suitable conditions of moisture, decomposition takes place rapidly and certainly. It suggests itself that the low degree of nitrification in the acid soils may have something to do with the matter. This, of course, only applies to one phase of usefulness of such incorporation of vegetable matter in the soil, namely the increase of nitrates brought about by bacteria feeding on the humus formed, and it is possible that the very heavy applications of nitrates in vogue in the Islands, though a much more costly method, may replace this bacterial action. The other phase of usefulness, the improvement of the physical condition of the soil, is presumably not so necessary in the island soils as a whole, though it is allowed that in some cases a deficiency is felt in this direction. In the circumstances, the biological study of Hawaiian cane soils in comparison with those, say, of the West Indian islands should prove of considerable interest.

Phosphates and potash.—In the present paper only the results obtained by the citric acid 1 per cent. test are given, as this method has proved most closely related to the field experiments; the various other chemical methods are stated to be dealt with fully elsewhere. Soils with 0·0025 per cent. of available P_2O_5 or less have been found to respond to applications of phosphatic manuring, while those containing 0·0040 per cent. or more do not. Between these limits a good many other factors become important, and it is therefore advisable to make field experiments in such cases, before deciding what action to take. For potash the percentage giving response has been found to be 0·024 or less, while 0·031 or over does not give any. But in these determinations, as has been already mentioned, a great number of other factors influencing availability must be considered. A definite relation exists between the availability of the phosphoric acid and the quantity and solubility of the silica present, a greater solubility of the latter going hand in hand with a greater availability and also assimilation of the phosphorus present. With regard to potash, on the other hand, there is apparently little or no such correlation. Higher soil acidity, again, aids response both with phosphatic and potash manuring. Lower lime content, especially in that form which is soluble in water saturated with carbonic acid, is accompanied by response with phosphates, as well as higher assimilation as judged by the amount in the cane juice. And the same appears to be the case in relation to the response with potash manuring. Lastly, there appears to be little or no relation between the size of the particles of the soil (mechanical composition) and the availability of phosphoric acid. On the other hand, higher clay content diminishes the response with potash; colour and organic matter also appear to be related to the availability of potash, this being more in the red clay soils than in those of the yellow type, and the availability of potash being lower in highly organic soils.

In consideration of these facts, the suggestions made as to the proper manures to apply are not guided only by the determination of the P_2O_5 and K_2O available in the samples, but allowance is made for the influence of other factors, as also a knowledge of the past history of the field or soil type.

Phosphoric acid and potash in cane juices.—Considerable progress has been made during the year between these substances in the juice of the cane and their availability in the soil where the canes were grown. In the present paper only published work is summarized, as the full chemical details are given elsewhere,[1] which is an advantage from our, mainly agricultural, point of view. The results obtained to date from plantation work indicate that 0·01 per cent. of P_2O_5 in the mill juice is the point below which phosphatic manures should be applied, while if the percentage is above 0·02 there is sufficient available phosphoric acid in the soil. In the Experiment Station work, analyses showed that plots at Oahu gave response to phosphatic manuring, while this was not the case at Waipio. The juice analyses from these two places gave 0·008 per cent. P_2O_5 in the first case and 0·026 in the second. The latter area was slightly higher in available phosphoric acid than the former but not markedly so, and the chief difference observed was in the relative solubility of lime and silica in the two soils. A close relation between these factors and the assimilation of phosphoric acid was thus indicated. This indication was supported by the fact that only a very slight increase in the P_2O_5 content of the juice was obtained from the manured plots over that from the unmanured.

As regards potash, in the work on plantations, a quite constant relation was shown between the K_2O in the juice and its availability in the soil. In this case, however, there was a greater relative increase in the manured plots (0·06 per cent.) over the manured, suggesting less influence of outside factors than in the case of phosphoric acid. The results in these experiments suggest that juice with less than 0·05 per cent. K_2O indicate the need for manuring, but that with 0·1 per cent. this would not be necessary. In the Experiment Station work no response was obtained in the plots at Oahu and Waipio on manuring, and the percentages of K_2O in the juice were 0·11 to 0·14 and 0·12 respectively. There was no marked increase in the manured plots, this being only 0·01 to 0·02 per cent. as compared with the 0·06 per cent. mentioned above.

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[1] See *I.S.J*, 1923, 214, 478.

Soil and Manurial Studies in Hawaii.

SOIL ACIDITY AND ITS RELATION TO FERTILITY.

Nature of acidity.—So far, aluminium salts and alumino-silicates appear to be the chief factors associated with the acidity of Hawaiian soils. They occur in the most soluble form on the humid coasts of Hawaii Island and in the uplands of the others. Acid-reacting organic matter also appears to be a factor in the solubility of these compounds. In lowland districts these factors are strongly involved with the acidity of poorly aërated tracts, where iron and manganese in the soils are usually more soluble. The former of these appears to be a factor only in very acid soils, while the latter is typically present in cases of low acidity. Both, however, play a secondary rôle to aluminium.

Relation of acidity to fertility.—In Indiana experiments with corn in 1913, low root vitality was attributed to soluble salts of aluminium. These were shown to be toxic to certain plants as well as related to soil acidity, and this opens up the question of their relation to the root vitality of two of the main crops of Hawaii, namely, sugar cane and pine-apples. Although work on the subject has not yet reached a definite stage, the author allows himself to make certain remarks. In Rhode Island experiments a proportion of 225 parts to the million of so-called "active" aluminium in the soil was found to be associated with loss of root vitality in plants to which aluminium salts were known to be toxic. The proportion is generally higher in Hawaiian soils. In the humid coast region of Hawaii Island, where the Lahaina cane first failed, the high organic content together with the great soil moisture give conditions for high solubility of aluminium salt; and this is also true of the tracts where the pine-apple is grown, these being upland. The indications, therefore, are that low root vitality in the two cases is associated with toxic action of the aluminium salts. A further indication of this is the low phosphate availability in upland soils and the consequent universal response to manuring with it.

Water and sand experiments show that aluminium sulphate has considerable toxic effects on sugar cane, and that Lahaina is specially sensitive. The chief corrections are liming and the application of phosphatic manures. Pot culture experiments on soil from a field, where even D 1135 shows indications of root rot, have yielded a marked response to phosphatic manuring, even with Lahaina.

C. A. B.

We regret to announce the death on January 16th, of Mr. JOHN WALKER, who was associated with his brother the late Mr. HUGH W. WALKER, in the development of the well-known refining firm of John Walker & Co., of Greenock. He was in his 73rd year.

We have received from Messrs. MANLOVE, ALLIOTT & CO., LTD., of Nottingham, an interesting mail-card relating to the types of filter-presses manufactured by them. This firm specializes in this apparatus; it is prepared to give expert advice, and, if necessary to carry out experiments. A copy of this well-illustrated mail card will be sent to anyone interested.

Replying to a statement made by L. J. LAVEDAN[1] regarding the alleged corrosive effects of "Natalite" motor fuel, CHAS. W. FETCHELL, Managing Director of Natal Cane Products Co., Ltd., of Natal, denies[2] that there has ever been any damage to cylinder walls or interference with the cylinder lubrication through the use of this alcohol-ether fuel, even after running 50,000 miles on it. Formerly it was found that the fuel attacked certain metal parts in Stewart vacuum tanks when water was present, but that was when the ammonia content (as originally made) was 0·5 per cent. Now "Natalite" contains only 0·05 per cent. of ammonia, and is stated to be without action on the galvanizing of tanks.

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[1] *Nassau Guardian*, April 10th, 1923. [2] *La. Planter*, 1923, **72**, No. 1, 14.

The Sugar Industry in Mauritius.

Department of Agriculture Report for 1922.

The annual Report of the Department of Agriculture of Mauritius, that dealing with the year 1922, as prepared by Dr. **Tempany**, has just come to hand. We give below, slightly abridged, that section dealing with the cane sugar industry.

The 1922-23 crop.—The final estimate of the 1922-23 sugar crop is given as 233,500 metric tons, as compared with 197,420 tons in 1921-22, 259,870 tons in 1920-21, and 235,190 tons in 1919-20. Of these 233,500 tons for 1922-23, approximately 97 per cent. will, it is anticipated, consist of *vesou* sugar; very little first syrup will probably be produced, and low syrup will account for approximately 3 per cent. of the total crop.

Factory work of 1921-22.—The average extraction of sugar, per cent. of cane handled, is estimated at 10·7, as compared with 9·90 in 1921-22 and 10·76 in 1920-21. The total tonnage of canes crushed during the 1921-22 crop amounted to 1,996,000 tons, giving a mean extraction of sugar of 9·90, per cent. of cane. This was the worst result experienced for the past 20 years, and was due to the exceptionally unfavourable climatic conditions during the crushing season. In fact, owing to the exceptionally low extraction figures recorded during the last days of December, 1921, and the beginning of 1922, many factories could not terminate their crop, and an amount of cane estimated at between two and three thousand acres was left standing for the succeeding crop.

Factory conditions in 1922.—Two factories were dismantled, viz., Pieterboth and St. Hubert, so that the total number in the Colony is now 52.

Conditions affecting the sugar industry.—The reaping of the crop for 1921-22 was conducted under very great difficulties; labour disturbances, combined with the heavy rains which fell at intervals throughout the reaping season, served to prolong the crop far beyond its normal limits. Added to this the torrential rains of the early part of 1922 further greatly handicapped those estates which had not finished their grinding operations; the result was that on many properties considerable areas of cane remained uncut. The reaping of the crop for 1922-23 proceeded much more smoothly. The majority of estates commenced grinding at an earlier date than usual, and the weather conditions throughout the reaping season were decidedly favourable for taking off the crop while labour conditions were easier than in the preceding year.

Labour conditions were somewhat easier during the year 1922 than they had been previously and rates of pay fell appreciably with the decline of the price of sugar, although still remaining considerably above pre-war level. A factor of importance in easing labour tension during the year has been the very important extension which has taken place in the use of tractors, ploughs and cultivators. No less than 37 tractors were imported into the Colony during 1922, the total value of ploughs and implements received amounting to Rs. 173,635. At present 47 tractors are at work on various estates. Of the various makes employed, by far the most popular is the Cletrac Caterpillar tractor. This machine has demonstrated its suitability for work under Mauritius conditions, and both the large and the small model have gained extensive employment. It was formerly thought that ploughs and tractors could only find employment on lands which were moderately free from stones, but during the year this view has been shown to be erroneous, and tractors are now being successfully used on some of the stoniest soils in

Mauritius, their use having been found to be perfectly feasible provided the stones have been properly ranged in rows across the field beforehand. Of the ploughs and cultivators in use, that which has come to the front during the past year has been the Oliver Disc Plough which has proved a most satisfactory implement for ploughing out cane stools and preparing land for planting, while the Oliver Double Mould Board Plough has shown its special utility in opening furrows for planting cane.

As indicated in last year's report information had been supplied during the year 1921 by the Tractor Experts of the English Ministry of Agriculture relative to types of tractors and implements likely to prove useful in Mauritius. In furtherance of the recommendations contained in this report the Government and the Chamber of Agriculture acting in co-operation arranged to import examples of the tractors and implements recommended by the Ministry, which had not previously been introduced into Mauritius. These importations arrived in 1922; the types imported were: the Austin Wheeled Tractor, the Wyles Motor Plough; the implements included the following: the Oliver Self-Lift Plough, the Ransomes, Sims & Jeffries double-breasted Self-Lift Plough, the Ransomes Dreadnought bar-pointed Plough packing 4 and 5, the Davey Sleep-Horse Hoe, the Corbett William Victory Horse Hoe, and the Ruston & Hornsby Self-Lift Plough. The full list of tractors recommended by the Ministry was as follows: the Cletrac, the Austin, the Beeman and the Wyles Motor Plough.

After the arrival of the tractors and implements, arrangement were made for the demonstration of the whole of the tractors and implements recommended by the Ministry of Agriculture at Mon Desert Sugar Estate during the month of November. In the course of this demonstration the Cletrac sustained the favourable impression previously formed concerning it, the Beeman demonstrated its suitability for work in the inter-lines of cane cultivation, the Austin also demonstrated that it can prove useful for preparation of land, while the Wyles Motor Plough showed itself to be unsuited to local conditions. It is in contemplation to hold a further series of trials during the current year, and to test the performance of the various machines.

In relation to cultivators, the most satisfactory form for use in the Colony still remains to be discovered; owing to their light construction most of the ordinary cultivators are not sufficiently strong to withstand the wear and tear consequent on use in the stony and gravelly soils of Mauritius, and the most successful cultivator, up to the present, has been one of simple design, made locally, and known as the "Daniel Cultivator." With the very considerable field for the introduction of implements which exists in the Colony, there should be an undoubted opening for manufacturers who can produce a type of cultivator suited to Mauritius conditions at a reasonable price.

Area under cultivation.—At the end of 1921, the area under cane cultivation was estimated at 172,360 arpents (or 179,780 acres) showing an increase of about 500 acres since the preceding year. During the year 1922 owing to labour difficulties and the fall in the price of sugar, a marked decrease took place, and at the end of 1922 the total acreage under cultivation in sugar was estimated to be 167,000 arpents (174,000 acres); that is to say, a decrease of approximately 5000 acres.

Indian cultivation.—In the year 1921 the area cultivated in cane by Indian planters was estimated at 79,000 arpents (82,400 acres), i.e., nearly 46 per cent. of the total area under cane cultivation.

In 1922 many pieces of land previously derelict, and which had been placed under cane cultivation on account of the high prices of sugar, were once more abandoned, while many small growers who had been tempted to place the whole of their holdings under sugar once more reverted to fruit and vegetable growing once the high prices for sugar had passed.

Resumption of importation of labour from India.—During the year owing to labour difficulties a considerable amount of discussion took place with a view to the possible resumption of immigration from India, and by the end of the year it had been arranged that a deputation representing the agricultural and official interests of the island should proceed to India with a view to discussing the question with the representatives of the Government of India.

Irrigation of sugar cane.—The La Ferme Irrigation scheme was completed by the commencement of the year 1922 and in January of that year the reservoir was finally filled up to its highest level. About 3000 arpents of land were irrigated from it during the year. The Experiment Station for the investigation of irrigation problems was completed during the year and is now in active operation. Work in relation to the La Nicolière scheme was pushed on vigorously during the year; it is expected that this scheme will be completed in five years' time.

Disposal of the sugar crop.—The Sugar Planters Syndicate (constituted under Ordinance No. 7 of 1921) continued operations, practically all planters adhering thereto. The mean prices at which the crops for 1920-21 and 1921-22 were sold were as follows: 1920-21, Rs. 50·68 per 50 kilos; 1921-22, Rs. 12·05 per 50 kilos. The account sales for 1922-23 have not yet been finally completed but the market improved considerably compared with the previous year, and it is anticipated that the average sale price will realize about Rs. 14·70. Although the sale price for 1921-22 was well above the average realized during the war, nevertheless, owing to the greatly increased cost of production, very few estates managed to make a profit on the year's working while the majority recorded a loss. During the year 1922-23, improvement in prices combined with a decreased labour tension materially eased the situation and the majority of estates will close their accounts with a balance on the right side.

Pests and diseases of the sugar cane.—The campaign for the control of *Phytalus Smithi* was maintained on the same lines as the preceding year, the proceeds of the special tax of 20 cents per ton levied for the purpose of providing funds for the control of the pest being devoted to the work as on previous occasions. The number of insects captured viz.: 26,599,496, was slightly more than the previous year. The parasitic wasps, *Tiphis parallela* and *Elis thoracica*, continued to give satisfactory results in the control of this pest; other diseases of the sugar cane were not markedly in evidence. Root disease was met with sporadically, as also was sugar cane smut and red rot.

Experimental investigations in relation to the sugar industry.—Experimental investigations were continued during the year by the Department of Agriculture, and comprised as on previous occasions experiments with varieties of sugar cane, fertilizers and manures. Laboratory investigations have comprised questions in relation to soils especially the application of molasses, composition of feeding stuffs, and the nutrition of the sugar cane. Statistical investigations have comprised an enquiry into correlation between crops and rainfall. At the Experimental Station for investigating irrigation problems at Medine, an extensive series of trials has been laid down with a view to testing the effect of application of water at varying rates and at varying intervals on the growth of cane, combined at the same time with trials of different varieties and different forms of manurial treatment.

Data relating to the Standard Capacity of Cane Factory Plant.[1]

By G. H. W. BARNHART.

In Noël Deerr's Circular 17, printed in 1913, an attempt was made to arrive at the necessary capacities for a standard factory; but, since this publication, conditions have changed, and with them requirements have necessarily altered as well. Following are the standard capacities which have been indicated on three different occasions:—

	NOËL DEERR.	HORACE JOHNSON.[2]	WILLIAM SEARBY.
Boiler heating surface (sq. ft.)	500	—	—
Juice heaters (sq. ft.)	40	30	35
Settling tanks (cub. ft.)	60	72	72
Filter-presses (sq. ft. of filtering area)	100	120	120
Evaporator quadruple effect (sq. ft. H.S.)	225	290	300
,, triple effect	170	215	215
Crystallizers (cub. ft.)	250	362	362
Coolers (cub. ft.)	—	1467	1467
Centrifugals (sq. ft. of screen area)—			
Shipping sugars	—	3.0	2·5
Second sugars	—	4·5	5·0
Total	6·0	7·5	7·5
Vacuum pans (cub. ft.) (ratio 1 : 1)	45·0	55·0	60·0
Vacuum pump displacement (cub. ft.)—			
Quadruple effect—dry	8·6	—	—
Triple effect—dry	11·5	—	—
Pan (per sq. ft. of H.S.)	0·4	—	—

It will be noted that the capacities for evaporators, pans and centrifugals have consistently increased since Mr. Deerr's data were published.

BOILER HEATING SURFACE.

So-called standard practice indicates 450 sq. ft. of boiler heating surface per ton of cane ground per hour, but several items affect this figure. First, we have a variation in cane fibre from 9 to 15 per cent. Other conditions being equal, this indicates a variation of 25 per cent. from the average of 12 per cent., and a boiler which operates economically with cane fibre at 12 per cent. will be pressed when the fibre approaches 15 per cent. Since the power consumption by the mill varies almost directly as the fibre in cane, it is conceivable that alteration from the normal amount of heating surface may result in insufficient power as the fibre increases. Secondly, water-tube boilers are conceded to be more efficient than the fire-tube type, and in calculating boiler horse-power it is allowable to use 10 sq. ft. in water-tube and 12 sq. ft. in fire-tube boilers per b.h.p. A third consideration is the economical or practical temperature of the escaping flue gases. A fourth is whether or not there is a surplus of fuel. Finally, the extent to which the "extra use of steam" is practised in the factory, i.e., whether a quadruple effect is used instead of a triple, or a pre-evaporator is used to supply vapours for heating, etc., will determine whether or not the supply of bagasse is ample for all requirements.

Several factories have found it necessary to function with but 70 per cent. of the required heating surface, and have been able to maintain operations. This condition has generally resulted in a flue gas temperature in excess of 500° F., which figure is deemed desirable for our conditions. At the same time the increased temperature has resulted in a greater capacity for a given installation. Assuming that 450 sq. ft. of heating surface per t.c.h. will enable the maintaining of a flue gas temperature of 500° F., then, owing to the greater mean temperature difference between the gases and the water in the boiler, when the flue gas temperature rises, the following areas will enable steaming at the same rate:—

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[1] Paper presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1923.

[2] *I.S.J.*, 1920, 156.

Temperature of Flue Gases, degrees F.	Sq. Ft. of Heating Surface.	Per Cent.
700	283	62·9
650	312	69·2
600	353	78·5
550	395	87·8
500	450	100·0
450	530	117·9
400	676	150·1

The question is whether we shall be extravagant with steam in the factory and continually increase the boiler heating surface so as to abstract the last possible heat units from the gases of combustion, and likewise the heating surfaces in the factory so as to utilize all exhaust, striving at the same time for a high CO_2 content; or whether we shall economize in steam in the factory by practising the extra use of steam, cutting down on the necessary heating surface in heaters, evaporators, and pans, by using higher pressures in the exhaust lines, and, by using less boiler heating surface, obtain a higher rating at a sacrifice in fuel resulting from a higher flue gas temperature. In other words, by using 350 sq. ft. of boiler heating surface per t.c.h., the flue gas temperature would be increased to 604° F., and the evaporation f/a 212° F. per lb. of bagasse of 42 per cent. moisture would be 2·82 against 3·00 at 500° F., the flue gases having a content of 12 per cent. CO_2 in each case, the evaporation per lb. of bagasse being 6 per cent. less with the higher temperature. A pre-evaporator combination with vapours heating all juices would more than off-set this loss.

JUICE HEATERS.

According to **KOPKE**, the maximum capacity in practice is 60 lbs. of juice per hour per sq. ft. of heating surface, when the juice velocity in the tubes is about 6 ft. per sec., when the steam pressure in body is 4 lbs. gauge, and when the juice temperature rise is from 80 to 212° F. This applies to unbaffled heaters; for the baffled type, the capacity is readily 20 per cent. in excess of the above. Based on tests and observations the formula for heating surface for baffled heaters has been developed as follows:—

$$\text{Sq. ft. of h.s. per t.c.h.} = \frac{R\ Td\ J}{Tm\ K},$$

where R = a constant = 10·23; Td = temperatures rise in °F; J = tons of juice per ton of cane (taken at 1·2 for mixed juice and 1·3 for clarified juice); Tm = the mean temperature difference between juice and steam; and K = decimal figure expressing efficiency of steam with steam at zero gauge as unity. (For each 1 lb. increase or decrease in pressure, this figure is increased or decreased 4·4 per cent.)

In this formula Tm and K vary with a change in pressure of steam, and as the exhaust pressure in a factory is reduced, the heating surface must be increased in proportion. For example, lowering the exhaust pressure from 8 to 3 lbs. gauge will necessitate increasing the heating surface 70 per cent. For each 1 per cent. of mixed juice on cane above or below 120 per cent., the heating surface is increased or decreased by 0·83 per cent.

SETTLING TANKS.

Standard practice requires 72 cub. ft. per t.c.h. but does not state whether this is to be in 3, 12, or 20 tanks, for intermittent settling. Calculation will show that for a given capacity, the greater number of tanks will result in the longest time of settling. Assuming that the time lost, or the time not available for settling, is equal to 150 per cent. of the time required for filling (the additional 50 per cent. being required for withdrawing the last clear juices, settlings and scums), then each of the following combinations will give 102 mins., of settling time:—

100 cub. ft. per t.c.h. in 4 units
90 cub. ft. „ 5 „
80 cub. ft. per t.c.h. in 7 units
72 cub. ft. „ 12 „

From a cost and labour standpoint, we would like to limit the station to four tanks, but this requires a larger unit and total capacity. Suppose, for example, that refractory juices necessitate holding one tank longer than the usual permissible period, then it will be held until its next turn comes. This would leave three tanks in service, and the available time would be reduced to about 80 mins. If 90 cub. ft. in five tanks were available, and one were isolated, the settling time of the remaining four would be reduced from 102 to 92 mins.; if 80 cub. ft. in seven tanks were available and one isolated, the time would be reduced to 98 mins.; and, if 72 cub. ft. in 12 tanks were available, one being isolated, the time would be reduced to about 101 mins. Obviously, the greater the number of tanks, the less will be the effect on the settling of juices if one happens to be withrawn from service temporarily.

EVAPORATORS.

Reference to the standards previously indicated will show that the H.S. required has been increased gradually from 225 to 300 sq. ft. for a quadruple effect, and that for some conditions 350 sq. ft. would be advisable. Calculations prove that for every lb. that the initial pressure is raised above 2 lbs. gauge, the evaporation is increased 12·5 per cent. Decreasing the syrup Brix from 70 to 60 increases the evaporation 11·5 per cent. on an average, the increase being greater at lower initial pressures. Decreasing the vacuum in last cell from 26 to 25 in. will decrease the evaporation 8 per cent. on an average, the decrease again being greater at the lower initial pressures.

The table gives the heating surface required under different conditions of initial pressure, syrup density, and vacuum in last body:—

INITIAL PRESSURE GAUGE.	26 in. Vacuum in Last Body		24 in. Vacuum in Last Body	
	13-70 Brix.	13-60 Brix.	13-70 Brix.	13-60 Brix.
2	350	303	431	376
3	314	274	376	333
4	282	249	334	298
5	255	228	302	271
6	234	211	274	247
7	216	196	251	228
8	201	182	232	212
9	187	171	215	197
10	175	161	200	184

The foregoing table indicates to what extent the requirements will vary. For a given syrup density and vacuum in the last body, the only factor which must be considered is the initial pressure, and this can be controlled within certain limits.

For each degree above or below 13° Brix of juice going to evaporator, one should decrease or increase capacity by 1·4 per cent. when evaporating to 70° Brix, and by 1·6 per cent. when evaporating to 60° Brix. For each 1 per cent. of mixed juice above or below 120 per cent. one should increase or decrease the evaporator capacity by 0·83 per cent.

Vacuum Pump Capacities.

For vacuum pans, the following quantities of air must be removed per sq. ft. of heating surface by a central vacuum, when the number of pans served and the temperature of injection water is as indicated:—

Number of Pans Served.	Temperature of Injunction Water, Degrees F. 75	80	85	90	95
1	0·40	0·48	0·60	0·79	1·12
2	0·36	0·43	0·54	0·71	1·01
3	0·30	0·36	0·45	0·59	0·84
4	0·24	0·28	0·36	0·47	0·67

For a quadruple effect, the following quantities of air must be removed per t. c. h.: 10·5, 12·5, 15·0, 17·0, 29·5, for the five temperatures above stated.

These figures are based on a vacuum of 27 in. in a counter current condenser; an evaporation of 20 lbs. per sq. ft. in single pans, an average of 18 lbs. for two, 15 lbs. for three, and 12 lbs. for four pans, and for the evaporation of 1·3 tons of juice at 13° Brix per t. c. h. to 70° Brix at quadruple effect. The same corrections would be made to pump capacities for a quadruple effect, as for evaporation from a quadruple effect. Since a volumetric efficiency of approximately 67 per cent. applies to vacuum pumps under these conditions it will suffice if the figures given are increased 50 per cent. This will give the pump displacement necessary.

Vacuum Pans.

Based on an 8-hour cycle for shipping sugar pans, and a 16-hour cycle for low-grade pans, the following capacities are required per t. c. h. when the cane polarization is 14, and the gravity purity of the syrup varies as below:—

	90°	88°	86°	84°	82°	80°	78°
Shipping	42·1	41·4	40·8	40·1	39·5	38·7	37·6
Low Grade	12·2	15·6	19·2	22·9	26·8	30·9	35·2
Total	54·3	57·0	60·0	63·0	66·3	69 6	72·8

For shipping sugar strikes, the time of boiling is controlled by the steam pressure available, by the ratio of heating surface to cubical capacity, and by the efficiency of the heating surface. The quantity of this depends on the amount of evaporation which must be accomplished. In pan work the temperature difference, as a strike progresses, is affected by the density of the massecuite, by hydrostatic head, and possibly by other factors, and transmission is diminished by viscosity and lessened circulation. For ordinary work the mean temperature difference with steam at 3 lbs. gauge is 32·8°F., and with steam at 8 lbs. gauge, it is 49·1°F. The efficiences of steam at 3 and 8 lbs. are 115 per cent. and 139 per cent. respectively, so that the amount of work done bears the ratio of 1 to 1·76. Evidently, where a ratio of heating surface to capacity of 1·2 to 1 is sufficient, when boiling with exhaust slightly under 3 lbs. gauge, a ratio of 0·7 to 1 should be just as effective with steam at 8 lbs. gauge. This confirms practice to a certain extent, for with the old Stade calandria pans using comparatively high pressure steam, the ratio of heating surface to capacity was generally less than one-half. Inasmuch as the additional heating surface required to bring the ratio of heating surface to capacity up to unity is a very small part of the cost of a pan installation, it seems advisable to provide for at least as many sq. ft. of heating surface as there are cub. ft. of capacity.

Crystallizers.

It is evident that the crystallizer capacity required depends upon many factors. The approximate formula: $R\ P\ (98 - J)/J$ gives the cub. ft. required per t. c. h. where: $R =$ a constant $= 184$; $P =$ polarization of cane; and $J =$

gravity purity of syrup; and where a crystallizer cycle occupies 13 days; the final molasses purity = 36; the final massecuite purity = 55; the second sugar purity = 80; = the final massecuite Brix = 99; and an allowance of 15 per cent. is made for foaming, etc. The capacities required are as follows:—

	SYRUP, GRAVITY PURITY.			
CANE, POLARIZATION.	90	85	80	75
10	164	281	414	514
12	196	338	496	676
14	229	394	579	790
16	266	450	661	902

The approximate figure of 400 cub. ft., now used, corresponds to a polarization of 14°, and a syrup purity of 84·8°. A more exact formula has been developed which reads as follows:—

$$\text{Cub. ft. per t.c.h.} = \frac{3\,PDH \times (S-J)\;(s-M)}{J \times (s-j)\;(S-M)}$$

in which P = cane polarization; D = number of days in crystallizer cycle (including time for filling, emptying and cleaning); H = number of hours factory grinds per week; S = gravity purity of shipping sugar; J = gravity purity of syrup; M = gravity purity of final molasses; s = gravity purity of second sugar; and j = gravity purity of second massecuite.

The purity of the second massecuite will depend upon the method of boiling in the factory; and the purity of second sugar will depend upon the density of final massecuite, and upon the number of centrifugals and cycle of operation; while the necessary crystallizer cycle will depend upon the individual juices. J varies according to condition of cane, fertilizer used, time of year cane is harvested, etc.

CENTRIFUGALS.

Allowing a 10-minute cycle for shipping sugars, a 60-minute cycle for low grades, and 6·5 cub. ft. per charge when using a 40 in. × 24 in. machine, the following capacities will be required in machines per t.c.h. when the cane polarizes 14:—

	GRAVITY PURITY OF THE SYRUP.						
	90°	88°	86°	84°	82°	80°	78°
Shipping sugar	0·1348	0·1328	0 1308	0·1284	0·1263	0·1239	0·1211
Low grades	0·1087	0·1375	0·1690	0·2015	0·2355	0·2720	0 ·3092
Total	0·2435	0·2703	0·2998	0·3299	0·3618	0·3959	0·4303

The corresponding screen area would be:

	90°	88°	86°	84°	82°	80°	78°
Shipping sugar	2·845	2·805	2·760	2·710	2·666	2·612	2·555
Low grades	2·292	2·901	3·568	4·250	4·970	5·745	6·580
Total	5·137	5·706	6·328	6·960	7·636	8·357	9·055

It will be noted that there is a very close agreement between the standard and the theoretical for 82° purity syrup and 14° polarization in cane.

The foregoing is an attempt to present standards for certain cane factory equipment which can be adopted and used in comparing the equipment of factories handling cane juices of very different characteristics.

A mixture of diluted molasses and calcium arsenate is reported by the Georgia Experiment Station as having given better results in boll weevil control than treatment with calcium arsenate dust, the value of the molasses being its attractiveness for the pests, which could in this way be killed off before laying their eggs.

Report on Milling and Clarifying Equipment in Hawaii.[1]

SEARBY SHREDDERS.

Altogether there are 16 shredder installations in Hawaii, 12 of which are doing excellent work. The other four have not given the same satisfactory results, but this may be due to the fact that they are located ahead of the crusher, taking cane direct from the carrier, instead of being placed between the crusher and first mill.

The Searby shredder is now operating in the West Indies, Java, Australia and South Africa. Following is a summary of a report from the Natal Estates, Ltd., which contains much information of interest and value to those operating these preparatory apparatus.

"Altogether 242,280 tons of cane containing an average fibre content of 15·26 per cent. have been crushed in our milling installation including a Searby Shredder, the first 134,987 tons being passed during 1921, and 107,203 tons during 1922. Hammers were replaced at the rate of a complete set for every 170,000 tons of cane; and 3 pairs of grids are used at an increasing distance from hammers of from ¼ in. to ¾ in. downward from anvil bar. As far as the effect of the exceedingly hard fibre in the Uba cane on the capacity of the Searby is concerned, it would seem that varying fibre contents make no difference whatever to either horse-power or to the durability of the hammers. The indications that guide us as to how long we shall continue using our hammers without turning or renewing them, are by watching the ammeter of the shredder motor and also by listening to the feed as it enters the mouth of the shredder. The former will show an increase in power rising from 170 h.p. under ordinary conditions to 250 when the hammers are worn. When the hammers are new they give a sharp intermittent feed delivered by each slat of the carrier, but when they require changing the sound will be almost continuous.

"Our milling installation has the following sequence: (1) Revolving knives above crusher; (2) 30 in. × 66 in. Krajewski crusher, with independent Corliss engine drive; (3) elevator to Searby shredder; (4) Searby shredder delivering on to a slat conveyor into; (5) the first mill, there being four 3-roll mills, 32 in. × 66 in.

"The greatest difficulty was experienced in making the first mill take the feed by the sloping chute originally supplied under the shredder on account of the woolley nature and increased volume of the bagasse, so that there was only a slight increase in the tonnage of canes crushed in 1922 above 1921, and choking was incessant; but with the introduction of the slat carrier, an average of 14 per cent. above 1920 tonnage was obtained. Further, it has been possible to bring down the losses in mill work by the addition of maceration water of from 17 per cent. in 1920 to 28 per cent. in 1922, so that our normal juice lost per cent. fibre was 59·8 in 1920 and is 46·0 in 1922.

"The shredder is considered the greatest modern improvement in milling; and fears as to continuous running, due to various causes, have been proved to be groundless. Owing to an increased and more regular running of plant, the steam supply has also been more constant, making it possible without additional fuel to evaporate the increased quantity of water in the milk-of-lime and to effect an increased sweetening-off of press muds in the new carbonatation process. The following is a tabulated statement showing the results of three years' working:

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[1] A synopsis of the Report of the Committee on Manufacturing Machinery (Mr. S. S. PECK, Chairman) presented to the Hawaiian Sugar Planters' Association, for the year ending September 30th, 1923.

	Year.	Tons cane per hour.	Bagasse. Sugar.	Bagasse. Moisture.	Normal juice lost per cent. fibre.	Maceration per cent.
Without shredder	1920	40·2	4·42	49·19	59·8	17
With shredder	1921	42·4	3·85	46·82	47·4	26
„ „	1922	46·0	3·73	48·18	46·0	28

"Returns have been taken over a period of three working weeks, from which it appears that the average quantity of cane crushed with this single train of 32 in. × 66 in. mills is nearly 52 tons per hour, which is remarkable. This record has only been made possible by the Searby Shredder."

Unstrained Juice Pump.

Previous reports have dwelt on the desirability of doing away with the raw juice strainers at the mills, because of the mechanical troubles connected with their upkeep, and because they are a very probable source of infection unless extreme care is taken in keeping them clean. Several attempts have been made to develop a pump able to handle raw juice containing cane particles, but without success. But engineers of the Honolulu Iron Works Company have now perfected one which has operated successfully for several weeks at the factory of the Oahu Sugar Company returning the third and fourth unstrained mill juices from the juice pans under the mills direct for maceration purposes. It is of the direct-acting plunger type with novel valves made of rubber which will take large particles of bagasse without being clogged up, the sketch reproduced above showing the pump in cross section. Oahu will have four of these installed for the 1924 crop to handle all the returned juices from both tandems.

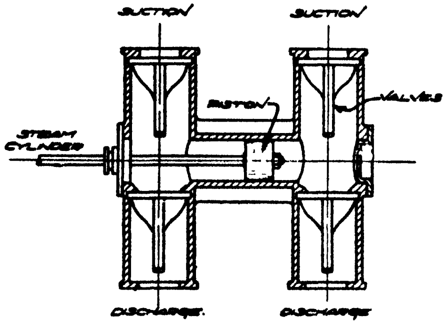


Fig. 2.

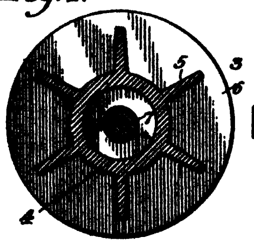


Fig. 3.

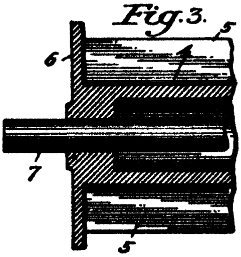
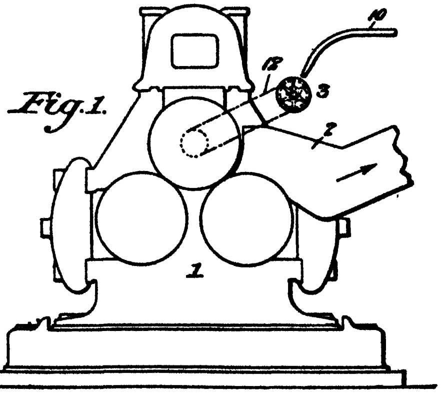


Fig. 1.



Maceration Distributor.

Straining the juice intended for return maceration has hitherto been necessary, because of the lack of a pump which would handle it when unstrained. When the juice is strained there is no trouble connected with its return to the mills, whether through scrapers, perforated pipes, or open troughs. But with unstrained juice with its greater amount of suspended cane particles of relatively large size, a new condition will arise.

To meet it, a different method of distributing is necessary, and the Honolulu Iron Works Company has introduced a device (see the 3 figures on page 89) which consists of a revolving cylinder *3* mounted on bearings and extending across the intermediate conveyor over the bagasse.[1] This revolving cylinder *3* has a number of fins or projections *5* extending between the flanged ends and forming gutters into which the juice from pipe *10* is distributed. Cylinder *3* is revolved by a belt, chain or other means from the mill roller, as indicated; and the juice with the "cush-cush" being distributed in the gutters, spreads itself evenly over the length of the cylinder, which cylinder when revolved spills the juice evenly over the blanket of bagasse.

STRAINERS.

Investigations last year on the "filtrability" of our raw sugar[2] tend to show that one of the causes of difficulty is corrected by removing as far as possible the finely divided *bagacillo* from the juice before clarification. Several strainers have been developed for this purpose. Peck's apparatus[3] has been in successful operation for an entire season at Kahuku and for part of the season at Puunene, and may be placed in a suitable position to take care of the mixed juice without prior straining and to return the separated fine "cush-cush" along with the coarser particles directly to the bagasse going to the following mill. The disposition of the separated material is a matter of convenience. At an installation for next season at McBryde it will fall directly on the intermediate conveyor; at Kahuku and Paia it falls into the juice intended for return maceration; at Puunene and at the proposed installation at Makaweli, it will fall into a scroll conveyor which carries it to the mill.

The screen openings in the present installations are those of a 100 × 100 mesh, equivalent to an opening 0·0055 inch square, the best screen material being Monel metal, though phosphor bronze or brass will also do. At Puunene a 6 ft. strainer took care of about 19,000 gallons juice per hour, but was somewhat crowded at times. An additional strainer will be installed this year, and the excess capacity will be diminished somewhat by using a smaller screen, e.g., 120 or 150 which will remove a further amount of the finer matter.

Advantages of this type over others previously used or attempted are: (1) Cleanliness, since, being compact and fitted with facilities for steaming out, it is easy to keep both screen surfaces clean without stopping the machine; (2) Capacity, since for a given size of screen, this type will take care of more juice per square foot of screening area than one where there is a tendency for the holes to become plugged up and closed; and (3) Efficiency, since in addition to removing all material larger than the size of opening of the screen, this strainer removes a portion of the suspended matter which is of smaller size. This is due to the straining action of the "cush-cush" collected by the paddles being drawn slowly through the juice in the outside containing tank. When the cane is dirty because of weather conditions, and when considerable amounts of soil and silt are present into the juice, an important amount is thus eliminated from process before the juice reaches the scale tanks.

A strainer has been in use at the factory of the Oahu Sugar Company consisting of a 50-mesh woven wire screen inclined at an angle of about 45°, the juice being delivered at the upper end, allowed to flow through to a receiving tank, and the screened "cush-cush" gradually worked to the lower end from which it is taken back to the mill in the regular "cush-cush" elevator.

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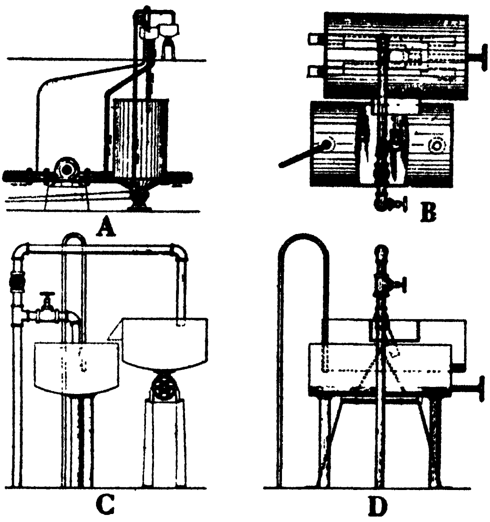
[1] See also U.S. Patent, 1,461,272; *I.S.J.*, 1923, 557.

[2] *I.S.J.*, 1923, 86.

[3] *I.S.J.*, 1922, 31; and 1923, 432, 466.

AUTOMATIC LIMING DEVICES.

The Petree automatic liming machine[1] has worked successfully at Puunene and Paia. A new and excellent form, shown in the sketches below, has been in use this season at Oahu. *A* shows the whole installation with the mixed juice pump, the pipe for introducing milk into the juice on its way from the supply tank under the scales to the pump, the sampling line running back from the pump discharge, the tank for milk of lime, the pump for circulating the lime milk, and the device for regulating the quantity of milk of lime, continuously added to the juice; while *B*, *C* and *D* are respectively top, end, and side views of the latter device.



The regulating device is installed close to the mixed juice scale so that it can be conveniently controlled by the scale man. It consists of two boxes, one stationary and the other movable, the stationary box being divided by a partition shown in *D* and *E*. A pipe leading back to the lime reservoir from one side of this partition returns the surplus milk-of-lime; and the sampling pipe discharges into the other end of the stationary box. A pipe carries the lime and the juice discharged from the sampling pipe from this end of the box into the mixed juice pump section. The movable box is mounted on an arrangement similar in principle to the cross feed of a lathe; the lime milk on entering it overflows in a broad stream, the outlet being shown in the drawing. The partition in the stationary box divides the stream of milk, a part being used in the juice and the surplus returned to the lime supply tank, while the amount of lime used in the juice is regulated by changing the position of the movable box. A further very close adjustment is made by slightly opening or closing the lower of the two valves shown in *C*, thus changing the amount of lime flowing over the outlet of the movable box. A considerable excess of lime milk above that required for the juice is circulated, which keeps it thoroughly mixed, and renders a stirring device in the supply tank unnecessary.

The lime is instantly mixed with the juice in the pump; and immediately after altering the adjustment, the juice running from the sampling pipe, shows the exact effect of the change. Delay in waiting for a quantity of lime to mix with a tank of juice, and uncertainty as to whether or not the mixture is complete, and the sample finally secured is representative, is entirely avoided.

Operation of this device[2] has been most satisfactory and decided benefits have accrued through its use. Though the juice at this factory has varied greatly in lime requirement since the installation has been used, the juice has been kept very evenly limed. But the precaution is taken to notify the scale man of a change in cane at the mill.

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[1] *I.S.J.*, 1923, 72.

[2] Patent applied for in the name of CHARLES J. FLEENER.

Some Notes on the Electrification of the Sugar Factory.[1]

By H. G. PURCELL.

With electric drive it is possible to effect economies in building construction due to the comparatively light weight of motors, the small space used, and the ease of running electric power circuits to any part of the mill. Machines may be located exactly where they are best suited to the process of manufacture, without regard to the question of drive, and attendance can be reduced to a minimum, control devices automatically protecting the motors and the machines they drive.

The steam consumption of mill engines and other large units is usually quite satisfactory, but direct-acting steam pumps and small steam engines are inefficient even when in the best mechanical condition. A duplex pump uses from six to ten times as much steam per h.p. per hour as a Corliss engine or steam turbine.

The electrical equipment of a sugar mill may be divided into two parts, the power station and the factory. The usual power house installation consists of one or more turbo-generators ranging in size from 300 to 1500 KW., supplying 3-phase current at 440 volts and 60 cycles. Although the turbine seems to be the most popular type of prime mover, Corliss engines are also used and one plantation is installing a Uniflow engine. Not long ago, S. H. MORTENSEN, of the Allis Chalmers Co., compared turbine-driven and engine-driven generators, referring especially to Corliss engines in sizes most suitable for sugar mill work. The principal advantages of engine-driven units are their simple design with easy access to all parts, large slow-moving bearings which are easily lubricated, good ventilation, and low peripheral speeds which tend to reduce collector ring trouble. The advantages of turbo-alternators are the small space required, high efficiency, and close regulation, being especially adapted to operating in parallel with other machines, and for supplying current to synchronous motors.

Under conditions found in the average mill there is not a great difference in the economy of the three types of prime mover previously mentioned. Using saturated steam at 125 lbs. gauge pressure, and with 4 lbs. back pressure, the water rate of a Corliss engine is 26 to 28 lbs. per h.p. per hour, steam turbine 23 to 25 lbs., and Uniflow engine 22 lbs.

In Hawaiian sugar mills the application of motors has not been extended to the crushing plant as it has in Cuba, but they are to be found in most of the other stations throughout the factory, operating conveyors, mixers, pumps, etc.

The importance of properly applying motors and motor control to pumps cannot be appreciated without realizing the dependence of the sugar factory upon this particular type of apparatus. The problem of selecting a motor for a specific pumping application involves careful consideration of the starting and running characteristics of the pump, and of the service required.

Owing to the construction of the plunger pump, with tightly packed stuffing boxes and sliding pistons, the initial breakaway torque may equal 125 to 250 per cent. of the normal full load torque, depending on the mechanical condition of the pump. Immediately on starting, the pump delivers full capacity per stroke, with the result that full load torque is required for the remainder of the starting period unless the pump is equipped with a by-pass or some means of relieving the pressure until the motor is up to speed. The running characteristics of this type of pump are simple. A positive amount of water is delivered with each stroke, and the power requirements vary directly with the speed or pressure.

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[1] Paper presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.

The action of a rotary pump resembles that of a multi-cylinder reciprocating pump, excepting that there is less friction and the starting torque is much lower.

The centrifugal pump differs from the two foregoing types in both starting and running characteristics. The average centrifugal pump requires about 30 per cent. of full load torque at starting, and if the discharge valve is left closed during the starting period, only 50 to 60 per cent. of full load torque is required when the motor reaches full speed. The following general rules apply to centrifugal pumps: (1) The head varies as the square of the speed; (2) the quantity varies directly with the speed; and (3) the h.p. varies as the cube of the speed.

With alternating current, the following capacities and types of motors are recommended for the different kinds of pumps: For plunger pumps squirrel-cage motors up to 5 h.p., as they can be thrown directly on the line, while for larger sizes, wound-rotor motors should be used as they will develop adequate starting torque without drawing excessive line current. For rotary pumps, squirrel-cage motors are frequently used in sizes up to 50 h.p. For centrifugal pumps, it is permissible to use squirrel-cage motors up to 500 h.p. In the case of installations requiring constant-speed motors of 75 h.p. or over, the synchronous type of machine is often used because of the power factor correction possible, even though it draws as much starting power as a squirrel-cage motor.

This is an important point, especially in a plant where the motors are not always fully loaded. Low power factor is due to lagging current drawn from the line by inductive loads, such as induction motors, arc lamps, etc., and its disadvantages are generally known to power users.

Improvement in power factor can be effected by the application of a synchronous machine which would operate as a power factor correcting motor, that is, part of the input would be used for energy and part for furnishing leading current to the line. The capacity of the motor and its location in the factory would be determined by local conditions, and following are a few general figures:—

	H.P. Motor		H.P. Motor
Unloader	10	Standard Drain Pumps	2
Unloader and Car Haul	20	Knives	75 to 100
Shredder	300	Mill Pumps	75 to 100
Lillie Evaporator (quadruple)	100	Juice Pumps	10 to 25
Vacuum Pump (17 × 10 twin)	30	Bag Washer	10 to 15
Maceration Pumps	3	Crystallizers	10 to 15

Centrifugals:—

	H.P. Motor		H.P. Motor
40 in. Machines (8)	100	30 in. Machines (21) Low Grade	25
30 in. ,, (16) Low Grade	50	30 in. ,, (8) ,,	15
30 in. ,, (12) ,,	30		

Time element relays, which ring a bell at the crusher station if either knife motor becomes overloaded, may be installed in the motor controls on both knife sets. This warning enables the operator to slow down the cane carrier in time to avoid jamming the knives and stalling the motor. Since this system has been adopted in the T. H., there has been a substantial increase in cane tonnage and no stops to clear the knives.

Tenders are being invited for the complete installation of a complete sugar factory by the Argentine Sugar Growers' Co-operation, at the town of Monteroz, in the Province of Tucuman. Tenders are to be opened on March 1st, 1924. The proposed plant is to include a mill with a grinding capacity of 700 tons of Java cane in 23 hours, and of a refinery for the production of white sugar. Payment will be made in debentures of the Co-operation, which will have the guarantee of the Tucuman Provincial Government, and will bear interest at 7 per cent.

Application of Molasses as Fertilizer for Cane Soils.[1]

By **H. A. TEMPANY**, D.Sc., F.I.C., F.C.S.,
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and **FRANCE GIRAUD**,
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PLANTING PRACTICE IN APPLYING MOLASSES.

It is on record that as far back as 1860 molasses had for several years been employed as a fertilizer in Mauritius; but its use did not become extended until about 1900. Now it is part and parcel of the recognized planting practice in that country, and farmers there are practically unanimous in admitting the benefits to be derived therefrom, although the methods of using it vary. Generally, it is applied to fields bearing or about to bear virgin canes, but it is also customary to apply it to ratoon canes.

In the case of virgin canes, it is poured into the cane holes sometime before planting, or put in the interlines between the young growing canes. In that of ratoon canes, it is either applied around the stools, or else in the interlines. Sometimes it is mixed with scums and ashes, and this mixture placed in the cane hole before planting; but the method varies to some extent with the locality and climate. Thus in the more elevated parts of the island, where canes take longer to mature, applications to virgin canes are more usually made in the interlines after planting, which practice is also followed on the lower lands, though to a less extent. When applying in the cane holes, it is usually put out some weeks before the canes are planted; for if it is used for young growing plants in the holes their death is liable. In such cases it is usual to spread it in the interlines. With virgin canes, the beneficial results are observed in the same season; but with ratoon crops the effect does not become evident until the next crop, and experience shows that the benefit extends over three or four succeeding crops.

As to the amount used, practices varies to some extent. The most usual rate is 20 tierces per acre,[2] which rate is not infrequently exceeded, as much as 15 tons per acre being sometimes given.

Regarding the benefit to be derived from the use of molasses as fertilizer, it is believed that on a cycle of one crop of virgins and five succeeding crops of ratoons the gain in yield amounts in the aggregate to as much as 20 tons per acre.

LABORATORY OBSERVATIONS ON THE SUBJECT.

EBBELS in 1908 in Mauritius[3] called attention to a paper by **ASHBY**[4] on the action of *Azotobacter chroococum* in fixing free nitrogen from the air, and the rôle carbohydrates can play in stimulating this process. He suggested that this organism was responsible for the effect observed with molasses, the stimulation of the nitrogen fixation increasing the fertility of the soil, and he adduced analytical results showing nitrogen contents in the case of treated fields very nearly double those of untreated plots. **DE SORNAY** in 1919, however, questioned Ebbel's results,[5] and produced laboratory data according to which soils to which molasses or sugar had been added first showed small increases in the nitrogen content, and afterwards a return to about the original figure. He expressed the opinion that the benefit is due to biological factors, the plant food in the molasses being unable to account for the whole of the effects. He also suggested that the effects might be due in part to the decomposition of the molasses assisting in the liberation of plant food in the soil, apparently by the conversion of the sugar into organic acids and carbon dioxide which attack the soil minerals. PECK[1] investigated the subject by observing the effect on certain biological properties, notably the rate of ammonification and nitrification. He demonstrated the existence of *Azotobacter* in Hawaiian soils, and showed that in all cases the effect of the application of molasses was to depress the rate of nitrification, particularly in the early stages, recovery taking place subsequently. He concluded that this application worked a harmful effect if applied to land receiving applications of fertilizers as nitrates, inasmuch as it caused a part of the nitrogen so applied to revert to unavailable or less available forms.

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[1] *Editorial Summary of Bulletin No. 28, General Series, Department of Agriculture, Mauritius.*

[2] The tierce is an old local French measure, about 190 litres, 20 being equal roughly to 3800 litres, that is 836 galls., or about 4 tons, per acre.

[3] *Agricultural News*, 1908, 227; 1910, 339; 1911, 179; 1911, 668. [4] *W.I. Bulletin*, 1907, 94.

[5] P. DE SORNAY, "La Canne à Sucre à l'Ile Maurice"; also *Bull. Soc. Chim. Sucr. Dist.*, 1919, 223.

ACTION OF AZOTOBACTER IN SOILS.

Azotofication cannot be regarded as a separate and independent process, but in reality forms a part of the complex series of bacterial reactions known under the generic name of the nitrogen cycle, which includes ammonification and nitrification, and may also comprise denitrification and the liberation of free nitrogen. It appears that the activities of *Azotobacter* and the other nitrogen-fixing organisms are very largely facultative. Given suitable conditions, they can have a very important influence in soil enrichment, but in any other circumstances they may not function at all. Further, it is to be remembered that if other conditions are favourable the addition of practically any form or organic matter may stimulate nitrogen fixation, as was demonstrated by TEMPANY[2] in cacao cultivation, when repeated heavy applications of heavy mulches or organic material to plots led to accumulations of nitrogen in the soil greater than could be accounted for in a balance of the soil nitrogen gains and losses, based on the manurial material added and the crop removed.

Taking these facts into consideration, and also the fact that the return of large quantities of organic material to the soil is part of the established system of agriculture in Mauritius, and that, moreover (as will be stated later), an extraordinary high nitrogen content is characteristic of the majority of the soils of the island, one is forced to conclude that, though azotofication may be and probably is an important factor in soil enrichment, the explanation of the beneficial results achieved from molasses application probably does not consist wholly in increased activity in this direction.

It seems probable that the question is in reality complex, and that the results may be due to the action of a number of super-imposed factors all of which are operative in a greater or less degree, the effect exerted by any one in particular probably varying with conditions at the point of application.

EXPERIMENTS WITH MOLASSES APPLICATIONS IN LYSIMETERS.

In planning these experiments, it was felt that the point to be kept in view was the conditions and changes taking place in the soil treated with molasses, in respect of the nitrogen content. Lysimeters, somewhat resembling those used by PECK,[3] were prepared, each fitted with a drainage tube. Five experiments were made, each in duplicate, these being as follows: (1) No addition to the soil; (2) 196 c.c. of molasses added; (3) 392 c.c. of molasses added; (4) 196 c.c. of molasses added, and two months later 15 grms. of sulphate of ammonia; and (5) no molasses added, but two months later 15 grms. of sulphate of ammonia. These 10 pots were watered with tap water once a week, the drainage bottles removed regularly, and their contents evaporated down for examination of their nitrate content.

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[1] *Bulletins Nos. 34 and 39, Hawaiian Sugar Planters' Association*; *I.S.J.*, 1911, 109; 1912, 353.

[2] *W.I. Bulletin*, 1914, 81.

[3] *Loc. cit.*

From the tabulation made of the results obtained, it is seen that the application of molasses had a marked influence on the process of nitrification. Thus, in the first two months nitrification was practically suspended, and the amount of nitrate removed in the drainage water was almost negligible. But the effect did not stop here, since comparison with data for experiments 1 and 5 show that the nitrogen originally present in the soil as nitrate was either denitrified, escaping as gaseous nitrogen, or (which seems more probable) became temporarily reverted to an insoluble form, i.e., organic nitrogen.

DISCUSSION OF THE ACTION OF MOLASSES WHEN APPLIED TO SOILS.

It is of interest to note that the soils of Mauritius, compared with those of most other countries, present noteworthy features and peculiarities, namely: a high bacterial count (1·8 to 6·0 million per grm.); a high nitrogen content (about 0·3 per cent.); a low production of nitrate, when the nitrate is not removed as formed; the marked tendency for nitrates and probably also ammonia to revert to the organic form; and (6) the presence of *Azotobacter* as a permanent and important agent in soil enrichment.

Discussing first the possible influence of the application of molasses on azotofication, our results have shown that this does not in general lead to increased fixation of nitrogen under Mauritius conditions, the reasons for which statement, and certain corollaries thereof, being as follows:

Azotobacter can draw for its existence on practically all forms of organic matter in the soil; and, as Mauritius soils are normally well supplied with organic matter, the addition of molasses is likely to have but little influence on the organism. *Azotobacter* can draw for its supplies of nitrogen on nitrogenous material already existing in the soil, provided it is in an assimilable form, and in the presence of ample supplies will do so rather than fix nitrogen from the air. Mauritius soils, in general, contain remarkably abundant supplies of nitrogen, which are regularly nitrified; consequently the activities of *Azotobacter* will be generally facultative, and will become evident only when supplies of the soil nitrogen become deficient. It seems not unlikely that *Azotobacter* may indeed be one of the organisms responsible for the reversion of nitric to organic nitrogen. Applications of molasses appear to favour the production of strains of *Azotobacter* of increased vigour, but it does not follow that this increased vigour necessarily expends itself in the fixation of atmospheric nitrogen in the soil, provided adequate supplies of assimilable nitrogen exists. It is, however, possible that in individual instances molasses applications may lead to an increased nitrogen fixation, e.g., in impoverished soils.

For these reasons we are forced to discard increased nitrogen fixation as the principal cause of the benefits observed, and are obliged to look for other explanations.

De Sornay's augument (already mentioned) is that, owing to the fermentation of the sugar which occurs when it is applied to Mauritius soils, decomposition products capable of assisting in the liberation of plant foods may be formed. His experiments on this point have been confirmed by us, it being found that when diluted molasses was mixed with soil it rapidly disappears, falling from 100 per cent. to 23·3 in 6 days, to 6·0 in 14 days, and 1·3 per cent. in 20 days. But the results both of DE SORNAY and of ourselves have not indicated that molasses applications have perceptibly increased the available mineral plant food in soils. Consequently, on this point, we conclude that, although the decomposition products of the molasses may influence to some extent the available plant food content, it is probably not the only factor in operation.

Up to the present, the most striking effect from the application of molasses is on nitrification. But the reason for this effect remains to be seen, since the addition of the organic matter contained in the molasses would hardly be sufficient to affect nitrification in this way. Additions of ordinary forms of organic matter to soils do not affect nitrification, as has been demonstrated by the work of ADENEY, CHICK, COLEMAN, STEVENS and WITHERS.

It appeared to us that insufficient attention had been paid to the fact that molasses when applied to the roots of growing canes causes their death, and it seemed obvious that an application capable of exerting such an effect could not be without direct influence on the biological population of the soil.

This matter was investigated by mixing known quantities of sterilized molasses with samples of soil, which were plated out for the enumeration of its micro-organisms, as compared with untreated soils. In all cases it was found that the addition of molasses exercised a profound influence on the population of micro-organisms in the soil. Generally the effect was greatly to augment the number. But the striking difference lay not so much in the increase in the number as in the difference in the type of the colonies appearing on the plates from the treated soils. Ordinary soil bacteria had been reduced almost to nothing; while, on the other hand, the majority of colonies on the plates consisted of torulæ, monilia, and other moulds, not ordinarily found.

The conclusion to be drawn is that molasses almost completely destroys (for the time being) the growth of the organisms ordinarily predominating in soils, and promotes the growth of other organisms, notably fungi and torulæ. It seems not unlikely that the great proliferation of organisms of the torulæ type which occurs may be largely responsible for the disappearance of nitrate recorded, which point is being investigated.

There is no doubt that the ordinary soil population is very greatly modified, and we are justified in concluding that the effect is in a measure one of partial sterilization, the principal effect of which lies in the elimination of soil protozoa. Protozoa exist in Mauritius soils, but they may be numerically scanty, so that it is not clear how far the benefits observed are due to their removal. In any event the first result of molasses application appears to be the elimination of active nitrifying organisms; but those responsible for the reversion of nitrates to organic nitrogen do not appear to be affected to the same extent, and may even be stimulated in the form of torulæ and moulds, the result being that after a short time all the nitrates existing in the soil become reverted to the insoluble form of organic nitrogen. Subsequently this class of organism becomes reduced, possibly owing to the removal of nitrates and ammonia. Afterwards, when nitrifying organisms once more begin to repopulate the soil, they produce nitrates at enhanced rates owing to the disturbance which has taken place in the biological balance of the soil, the result being practically the same as in other cases of partial sterilization.

We therefore conclude that a considerable portion of the benefit derived from molasses applications is due to the exercise of the partial sterilization effect, leading to enhanced nitrification and accumulation of nitrates in the soil at the time when it is of the greatest benefit to the developing cane plant.

This, however, does not afford a complete explanation of the yield recorded in subsequent crops of ratoons. It is believed that this effect may be attributed in part to the increased vigour imparted to the stool as the result of the favourable conditions induced during the first year of growth, and is not entirely the result of difference in soil fertility persisting beyond the first year. Further, it must not be overlooked that the addition of organic matter and plant food in the molasses must tend to permanent soil enrichment, which will be bound to be felt to some extent in subsequent crops of ratoons.

In any case in attempts to account for the effect of the application of molasses, due account must be taken of the direct action of the manurial material applied in the dressings of this product. Moreover, it has been pointed out that molasses exerts a perceptible influence on the physical texture of soils to which it is applied, improving their condition, and making them easier to work.

Comments on the Synopsis of Mill Data for Philippine Centrals for 1922-23.[1]

By E. T. WESTLY.

Quality of cane.—As is seen from the tabulation of control data, 13·84 per cent. polarization in cane was the average figure for the 1923 crop; whereas in 1922 the figure reported was 12·98 or 0·86 less. Fibre in cane was practically the same for the two seasons being 11·04 and 11·05. Comparing the juices for the two crops we find that the average purity of first expressed juice was 86·74 in 1923, and for 1922 it was 84·07. Negros had by far the best cane; while another interesting fact is the high fibre content reported by Mindoro.

A favourable growing season may have had something to do with the much better cane qualities in 1923. But in the writer's opinion the fact that this year the cane reached the mill quicker after it was cut had more than anything else to do with it.

What the better quality of cane in 1923 did to the sugar output for that crop is readily seen in the following comparison. The 1923 crop of 1,482,790 tons of cane with 1923 quality of cane and 1923 recovery yielded 182,133 tons of 96·40 polarization sugar. Using the same tonnage of cane and the same recovery, but substituting the 1922 figures for quality of cane, we find that the 1923 crop would only have amounted to 170,784 tons of 96·40 polarization or 11,349 tons of sugar less than we actually made. Further, the overall recovery was also much better in 1923 than in 1922, and no doubt the better quality of cane again had something to do with this.

While comparing the two crops, let us see what the better quality of cane together with the better factory work did financially to the 1923 crop. In 1923 the average tons of cane per ton of polarization bagged was 8·14; in 1922 it was 9·38. Using 9·38 on the 1923 crop we get 158,080 tons of polarization or 163,983 tons of sugar of 96·40 polarization. Actually 182,133 tons were bagged in 1923, but we would only have bagged 163,983 tons if the conditions had been the same in 1923 as they were in 1922. The difference amounts to 18,150 tons of sugar.

Milling.—Coming back to the extraction we see that the average was much better in 1923 than in 1922; viz: 94·51 against 93·39. This is very gratifying when we also consider that the tonnage fibre ratio was higher. During 1922 not a single factory obtained 96 extraction; but in 1923 three factories report over 96 extraction and one over 97. One thing that has helped is the larger amount of maceration, namely 20·15 against 14·88. It might not be amiss to look into the efficiency of the maceration in most of our mills; for there we have a field for improvement with hardly any extra expense.

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[1] *Sugar News*, 1923, 4, No. 10, 541-544.

In regard to the average bagasse figures the 1923 season had a lower per cent. of polarization and moisture content.

Comparing the mill juices, it is seen that the average drop in purity from first expressed juice to last mill juice in 1923 was 12·01, while in 1922 it was 11·26. This larger drop in 1923 is only natural with the higher maceration and higher extraction. The drop between first expressed juice and mixed juice was 2·51 in 1923, and 2·94 in 1922. One would have expected a larger drop in 1923 for the reasons just mentioned. That the drop was less in 1923 with a higher extraction is no doubt due to the better mill sanitation and fresher cane brought to the mills during the last season.

It is rather interesting to compare a few figures from Hawaii with our conditions here.

	EXTRACTION.	DILUTION.	DROP IN PURITY. First to last mill.	First to mixed juice.
Average figures for the 1922 Hawaiian crop	96·98	34·75	17·71	3·11
Average Philippine figures 1923 crop	94·51	20·15	12·01	2·51
Difference	2·47	14·60	5·70	0·60

Thus, Hawaii gets 2·47 higher extraction using 14·60 more dilution, but has 5·70 bigger drop from first mill juice to last, and 0·60 bigger drop from first expressed juice to mixed juice. There was hardly any difference in the purity of the first expressed juice between the two countries. The average purity of first expressed juice in Hawaii was 86·44, and in the Philippines, 86·74. The above figures are worthy of consideration, when going into high extraction. Does it pay under Philippine conditions to go after extractions over 96?

Clarification.—The average increase in purity from mixed juice to syrup was 1·13 in 1923, against 1·38 in 1922. This indicates that the clarification during the last season was not as good as it should have been, and perhaps the less amount of lime used has some bearing on this. During 1922, 0·94 kilo was used per ton cane and during 1923 only 0·76 kilo. The tendency in Hawaii has been to increase the amount of lime, but to overlime requires a maximum settling tank and mud press capacity. Some factories report a decrease in purity. There should be no reason for this, unless a large quantity of low purity muscovado was introduced before the juice reached the syrup stage.

The polarization of the press-cake is slightly better in 1923; the average figure for that year being 4·10 against 4·42 for 1922.

Evaporation.—The rate of evaporation was about the same for the two years Some of the factories are no doubt lacking in evaporator capacity as they report rather low Brix of syrup.

Commercial sugar.—There has been an increase of 0·15 in polarization. The moisture content is 0·05 less for 1923, being 1·01 as against 1·06 for 1921-22; but it should be reduced to below 1·00 or as low as possible, as it is a well-known fact that the drier the sugar, the better it will keep.

Final molasses.—The gravity purity of the final molasses has dropped from 39·42 in 1922 to 38·54 in 1923, a very gratifying result as most of the factories were running at full or over capacity most of the time.

General comments.—Comparing the two years as a whole, it is very evident that the results obtained in 1923 are far superior to those found during 1922. Most of the factories have made a good step forward; but there is still room for great improvement.

SYNOPSIS OF MILL DATA OF PHILIPPINE CENTRALS FOR 1922–23.

NO. OF CENTRAL.	1.	2.	3.	4.	5.	6.	7.	Totals and Averages of 13 Centrals.
MILLING PLANT[1]— (Sizes in inches.)	1 RK, 2 RC 26 x 54, 9 RM 26 x 54	1 RK, 2 RC 30 x 62 9 RM 30 x 60	1 RK, 2 RC 30 x 78, 9 RM 34 x 78	2 RK, 2 RC 27 x 72, 12 RM 34 x 78	4 RK, 2/2 RC 32 x 78 9 & 15 RM 34 x 78	2 RK, 15 RM 34 x 78	1 RK, 3 RC 26 x 54. 9 RM 26 x 54	
Normal capacity per 24 hours	400	800	1200	1600	2500	1500	500	
CANE GROUND—								
Tons	8,929·41	113,594·47	113,557·22	74,805·41	231,842·33	137,698·25	51,555·80	1,482,790·01
Polarization per cent.	12·38	14·27	14·57	12·22	12·89	14·45	13·68	13·84
Fibre per cent.	11·60	11·14	9·48	11·34	11·20	11·25	10·73	11·04
Tons per ton sugar due cane	9·40	8·06	7·75	9·84	9·19	7·43	8·55	8·14
MILLING—								
Extraction	89·90	92·38	94·64	93·19	93·32	96·10	92·72	94·51
Extraction ratio	0·87	0·68	0·57	0·60	0·60	0·35	0·68	0·50
Tons per hour	13·50	34·01	51·83	54·55	84·13	59·01	22·48	53·19
Tonnage fibre ratio	11·70	22·68	17·55	18·11	22·30	16·76	17·87	18·52
Dilution per cent.	3·49	18·36	22·75	21·49	16·02	26·64	11·05	20·15
FIRST MILL JUICE—								
Brix	17·80	19·68	19·71	17·70	18·50	19·29	19.10	19·08
Polarization	14·88	16·95	17·29	14·46	15·56	17·28	16·65	16·55
Purity	83·60	86·13	87·69	81·69	84·08	89·58	87·20	86·74
Pol. cane pol. 1st mill juice	83·20	84·19	84·27	84·51	82·84	83·62	82·16	83·63
MIXED JUICE—								
Brix	17·20	16·68	15·11	14·05	15·60	14·88	17·20	15·47
Polarization	—	—	—	—	—	—	—	—
Purity	81·50	84·06	85·22	79·78	80·97	86·76	85·10	84·23
LAST MILL JUICE—								
Brix	12·90	5·94	5·18	5·33	6·32	3·20	9·00	4·96
Polarization	—	—	—	—	—	—	—	—
Purity	75·40	74·41	78·69	73·27	70·06	75·63	76·80	74·73
SYRUP—								
Brix	64·10	65·35	64·93	64·09	62·38	58·61	57·60	62·31
Polarization	—	—	—	—	—	—	—	—
Purity	83·70	85·42	84·17	80·39	82·21	87·89	85·30	85·36
Purity in increase	2·20	0·36	—1·05	0·61	1·24	1·13	0·20	1·13

SYNOPSIS OF MILL DATA OF PHILIPPINE CENTRALS FOR 1922-23.—*Continued.*

NO. OF CENTRAL.	1	2.	3.	4.	5.	6.	7.	Totals and Averages of 13 Centrals.
BAGASSE—								
Polarization per cent.	—	4·39	3·97	3·35	3·66	2·46	4·37	3·31
Moisture per cent.	—	49·18	46·75	49·79	47·14	47·60	47·69	47·33
Fibre per cent.	—	44·92	48·20	45·64	47·64	49·15	46·62	48·24
Polarization per cent. cane	—	1·09	0·78	0·83	0·86	0·56	1·01	0·76
Pol. per cent. pol. of cane	—	7·63	5·36	6·81	6·68	3·90	7·35	5·44
Pol. per c. fibre, or milling loss	—	9·77	8·24	7·34	7·68	5 01	9·37	6·86
Per cent. cane	—	24·80	19·67	24·85	23·51	22 89	23·02	22·89
PRESS CAKE—								
Polarization per cent.	7·30	7·94	2·90	4·16	5·48	2·62	4·58	4·10
Moisture per cent.	—	66·79	69·00	62·68	64·15	68·22	65·08	66 27
LIME—								
Kilos per ton cane	0·59	0·44	1·03	0·47	0·57	0·56	0·89	0·76
FINAL MOLASSES—								
Gravity solids	85·00	87·29	91·70	85·33	88·31	87·54	86·00	88·29
Apparent purity	32·10	32·09	31·61	33·29	—	31·86	38·80	32·40
Gravity purity	34·60	37·92	36·28	39·90	39·57	39·27	43·00	38·54
Tons	230·00	2,748·88	3,481·94	4,097·77	8,262·76	2,913·70	1,235·91	36,401·30
TOTAL LOSSES—								
Polarization per cent. cane	2·14	2·32	2·09	2·45	2·43	1·48	2·41	2·00
Pol. per cent. pol. of cane	17·25	16·26	14·33	20·05	18·87	10·28	17·59	14·46
SUGAR (DUE CANE GROUND)—								
Tons	949·94	14,093·61	14,652·54	7,602·18	25,227·67	18,532·74	6,029·92	182,133·40
Polarization per cent.	96·30	96·32	96·74	96·13	96·11	96·33	96·39	96·40
Moisture per cent.	—	1·48	0·92	0·84	0·92	0·85	1·07	1·01
Weight per cent. cane	10·64	12·41	12·90	10·16	10·88	13·46	11·70	12·28
Polarization per cent. cane	10·24	11·95	12·48	9 77	10·46	12·97	11·27	11·84
Pol. per cent. pol. of cane	82·75	83·74	85·67	79·95	81·13	89·72	82·41	85·54
Pol. per cent. pol. of juice	92·05	90·65	90·52	85 79	86·94	93·36	88·88	90·51

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[1] RK, revolving knives; RC, rolls in crusher: RM, rolls in Mill.

Covering with Evaporator Syrup in the Manufacture of White Sugar.[1]

By H. E. LESUEUR.

WATER CONSUMPTION AT THE CENTRIFUGALS.

During the last campaign, efforts were made in one direction and another in order to bring the use (or rather misuse) of the water used for covering down to a more reasonable limit. One can well see the importance of this, since an excess of water must be evaporated, while the dissolved crystal must again be returned to the pans.

The water consumption at the centrifugals is expressed in the returns of the factories under the control of the Klatten Experiment Station (Java) by a single figure giving this volume; but it would seem more desirable to show the quantity of crystal which is again brought into solution by the covering operation. A figure stating the quantity of crystal which has been dissolved per 100 of crystal obtained seems applicable. Thus a value of 30 means that per 100 parts of crystal obtained, 130 of crystal were originally present in the massecuite.

For the calculation of the crystal originally present in the cuites produced, one must know the weight in addition to the crystal content; but, as direct weighing is hardly possible in the circumstances, the calculation must be made from the total volumes of cuite multiplied by their respective specific gravity values. It is admitted that in following this plan a rather considerable error may arise; and that further by using the polarization in place of the true sucrose (as was done) the crystal content may be too high.

Therefore, although the final value under these conditions can have no great degree of accuracy, and must be regarded as a round figure, nevertheless it can serve well enough for the purpose of comparison. In the factories under my control, it was found to vary from about 25 to 70, so that in the first case 100 piculs of S.H.S. were obtained from 125 piculs of crystal in the different cuites; while in the second about 170 piculs of crystal in the cuites were necessary for the yield of 100 piculs of S.H.S.

EXPERIMENTS MADE ON SYRUP COVERING.

With the purpose of limiting this considerable solution of grain, arrangements were made at Delanggoe factory to carry out long conceived plans having as their object the substitution of evaporator syrup (thick-juice) for covering water. Although convinced of the important advantages which syrup should possess, compared with water, it was at first feared that these might be negatived by high mechanical losses due to spilling and leakage.

It was found, however, that such losses could be reduced to quite insignificant proportions; and the experiments at the factory named were so favourable that, during the last two months of the campaign, covering was carried out exclusively with syrup. It must be added that after covering with syrup the crystals were treated with superheated steam. The sugar produced in this way was normal; and in my opinion syrup covering does not lead to any reversion of the appearance of the S.H.S.

But the most important advantage appears to be the fact that no extra water requires to be evaporated in the pans, which means economy of steam. Take, for example, a factory producing daily 2000 piculs of S.H.S. If per 100 of product obtained, 40 piculs of crystal are dissolved (which is about the average of the final returns from my factories), then per day 800 piculs of crystals are dissolved to clear syrup. Assume this clear syrup of about 70–75° Brix to be a mixture of green syrup of 80–85° Brix, and a pure sugar solution of 67° Brix, that is a solution containing 2 parts of sucrose and 1 of water. One must therefore daily evaporate 400 piculs of water, which, if syrup covering were adopted, would result in an economy of about 400 piculs of steam, so that daily about 175 piculs of bagasse less would be used, or the equivalent of that amount in extra fuel.

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[1] Abridged translation from *Verslag der Vergaderingen van de Vereeniging van Adviseurs bij de Java-Suikerindustrie*, 1923.

Then, again, the decreased solution of crystal when using syrup is an important advantage. Experiments made to examine this point have given varying results, though they proved that in each case there was an increase in the centrifugal yield, this in round figures amounting to 5 to 15 per cent., and in some cases even more.

In regard to the installation, measuring tanks for the syrup, each holding about 60 litres for 42 in. machines, are placed above the after-battery, which tanks are in communication with a pressure tank having an adjustable over-flow. They are also provided with a 2-way cock, by which they are filled from the pressure tank, or discharged through a piece of rubber tubing during the covering operation. It is thus possible to measure a determined quantity of syrup for use in each covering. One measuring tank can serve two machines.

DISCUSSION.

Mr. A. **SCHWEIZER** asked whether there was not a danger in using acid syrup from the point of view of the keeping quality of the sugar being affected, and also whether the acid remaining would not invert the sugar during the treatment with superheated steam. He added that, according to De Haan's paper read before the previous conference, the solution of sugar in water covering was very great, greater, in fact, than had just been stated.

Mr. **LESUEUR** replied by saying that there need be no hesitation in using sulphitation syrup, since after steaming it is rapidly expelled; in fact, most of it has already been swung out before the temperature of the sugar is raised by the steam.

Antigua Sugar Factory, Ltd., according to the annual report for the year ending September 30th, ground 89,396 tons of cane of 13·34 per cent. sucrose and 83·39° purity, the recovery being 82·96, and the yield of sugar per ton of cane 11·53 per cent., making the production of sugar 10,308 tons. Average price realized for the sugar was £25 13s. 10d., resulting in a profit of £57,555, of which £28,777 was alloted to planters, making the rate paid for cane 34s. 8d. per ton. After deductions, and the payment of 7½ per cent. dividend, the balance remaining was £2,714.

A refinery having an initial melting capacity of one million lbs. of sugar per day is being erected at Texas City, U.S.A., its designer being Mr. **ED. P. EASTWICK**, Jr., of New York.[1] It will be electrically equipped, and its main plant units are as follows: Five 619 H.P. water-tube boilers, burning oil, for 200 lbs. working pressure, each with a superheater for 100° F.; two 1000-kilowatt steam turbine generators furnishing power at 480 volts, 3-phase, 60-cycle; 36 char filters, 9 ft. 7 in. diam.; eighteen 64-retort kilns; three coil pans, 14 ft. 6 in. diam.; a Lillie sextuple evaporator; six juice heaters, one using pan vapour, and one evaporator vapour; three crystallizers of 1900 cub. ft. capacity each; two melting pans, 8 ft. 3 in. diam.; one hot water heater, 12 ft. diam.; 16 bag filters of 333 bottle capacity; six electrically driven Cresson-Morris centrifugals having 48 × 24 in. Lewis self-discharging baskets for the washing station; 24 machines of the same type, but 40 × 24 in., for the pan-house installation; and two sets of granulators having Kent saw-tooth buckets. This refinery will have exceptional facilities for the receipt and shipment of its sugars.

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[1] *Facts about Sugar*, 1923, 17, No. 10, 226-227.

Brevities.

Yeast which has been dried on rollers to the form of reddish-brown flakes forms a valuable feeding stuff.[1] It may contain 42 per cent. of digestible protein, and have a nutritive value of 1 : 1, and a starch equivalent of 67·2. It is of particular value for young growing stock; but owing to its richness in protein it should never constitute more than 10 per cent. of the total meals or cakes fed in the ration. It is inadvisable to mix it with sugary material, unless it is certain that the desiccating process has resulted in the death of the enzyme inducing fermentation.

In order to determine the ripeness of cane, Mr. MAX SCHMID, of Ingenio San Martin, Argentina, takes an average sample from the field, cuts the stalks in the laboratory from internode to internode, crushes the internodes, and examines a drop of the resulting juice by the refractometer. Working in this way, he found the following figures indicating the dry substance content: first internode from the top, 11·2 per cent.; second, 11·8; third, 12·6; fourth, 13·9; fifth, 17·0, sixth, 18·1; seventh, 18·2; and eighth, 18·1. The interpretation of these results was that the cane was still unripe; but that, as it had to be harvested, it should be cut at the fourth internode.

An amicable agreement has been concluded between the Great Western Sugar Co., of Denver, Colo., and the beet growers, by which it is estimated the latter will receive about 50 cents a ton, or more, above the price allowed in the 1923 contract, provided the sugar content of their roots runs high. The new scale provides a guaranteed initial price of $5·50 per ton. When, for example, the nett price being received by the Company for sugar is 4·25 cents per lb., a profit sharing feature comes into operation if the roots contain 17·5 per cent. of sugar, or more, the price paid to the farmer then being $5·68 per ton, while for 18 per cent. roots it would be $5·86 per ton.

According to a Department of Overseas Trade report, the area under sugar cane in Peru is given as over 600,000 acres. Sugar grows in the coastal valleys, the principal areas being in the departments of La Libertad and Lambayeque. The production, which in 1914 was 223,369 tons, has increased annually, and in 1921 reached 318,775 metric tons. In 1922 it was probably about 350,000 tons (of which 127,799 tons were produced in the Chicama Valley), and doubtless 1923 will see a bigger yield still. Prices have shown considerable fluctuations. In September, 1922, the price f.o.b. Peruvian port, was 12s. 6d. per quintal; in May, 1923, 32s.; and in August, 1923, half that figure.

Messrs. Duncan Stewart & Co., Ltd., of Glasgow, have secured the contract for a new factory in Jamaica, in the St. Thomas District. It is to have a capacity of 10,000 tons of raw sugar per crop, and has been designed so as to be easily increased in size should the amount of cane be available. The milling plant, which will consist of 13 rollers, is to be driven by one high-pressure steam engine, all other machinery in the factory being electrically driven. The electric generators will be driven by high-speed totally-enclosed vertical engines, which along with the mill engines will receive their steam from high-pressure water-tube boilers, fitted with superheaters. Careful consideration has been given to keeping the plant as simple as possible, and it has been designed on the most modern lines to give ease in supervision and control.

In a paper read by Mr. RAY D. HUDSON, of the Division of Simplified Practice, Department of Commerce, Washington, U.S.A., before the American Society of Agricultural Engineers, the benefits of standardizing manufacturing machinery were summarised briefly as follows: In designing, the work is easier by the availability of standard specifications representing the best thought and practice of the industry concerned; in manufacturing, there are are fewer sizes to deal with, which means numerous advantages resulting in lower costs; in marketing, though competition is stimulated, larger foreign as well as domestic business becomes possible; in operating, there is greater satisfaction, performance being as a whole more certain; and in "servicing" stocks of spares are reduced and are more readily maintained. All these advantages mean that the owner benefits as the result of: Lower purchase price; lower maintenance cost; better quality of machinery; and altogether greater value per dollar spent.

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[1] *Journal of the Board of Agriculture*, 1924, 30, No. 10, 982.

Publications Received.

Allen's Commercial Organic Analysis. Edited by Samuel S. Sadtler, S.B.; Elbert C. Lathrop, A.B.; and C. Ainsworth Mitchell, M.A., F.I.C. Volume 1. Fifth Edition, revised, and in part re-written. (J. & A. Churchill, London). 1924. Price: 30s. nett.

Another edition of this standard work has been called for, and Volume 1, dealing with Alcohols, Malt and Malt Liquors, Wines and Potable Spirits, Sugars, Starches, Paper and Pulp, etc., has now been published. It has been compiled under the general editorship of Messrs. S. S. SADTLER and E. C. LATHROP, of Philadelphia, and Mr. C. A. MITCHELL, of London, assisted by several contributors whose names are well-known as specialists in the respective subjects on which they write. Mr. LEWIS EYNON, of Eynon & Lane, Analysts to the Sugar Association of London, is responsible for the section on Sugars. In general the arrangement of his contribution is on the same lines as were followed by the previous writer of this section, but the whole has been revised, new matter having been added, and certain methods, which previously should hardly have found a place, have been excluded. Mr. EYNON has shown good judgment in the selection of his material, and his writing is throughout characterized by exactness of statement and by clarity of description. He appears to have well borne in mind the requirements of a general treatise of this kind largely intended for the use of analysts whose usual work may cover a very wide range; and we think there is little doubt that his contribution to this new edition of "Allen" will be accepted both in this country and in America as an excellently lucid and concise statement of the most necessary information on the subject of the analysis of sugar and sugar products. It calls for little criticism, except to suggest that perhaps here and there a certain amount of compression might have been effected, particularly in the case of a certain chemist's work on the double polarization method, which, in our opinion, receives, an unduly lengthy description; that a summary of Jackson & Gillis' valuable conclusions regarding the same process might well have been given; and that certain of the analyses which are reproduced might have been replaced by figures more recently obtained. Lastly, we would remark that it is regrettable a description of the volumetric process, using methylene blue as internal indicator, which promises to become a standard procedure, being both rapid and accurate, has not been included, though in all probability the explanation of this omission is that the research was not sufficiently advanced when the contribution was written. In regard to the other sections in this volume, it may be mentioned that Mr. L. M. BURGHART is responsible for that on Alcohols; Mr. JULIAN L. BAKER, for that on Malt and Malt Liquors; Mr. EYNON for that on Wines and Potable Spirits; and Mr. T. H. POPE for that on Starch and its Isomers.

L'Hérédité chez la Betterave Cultivée. By Jacquès Levêque de Vilmorin. (Gauthier-Villars et Cie, Paris.) 1923. Price: 30 frs. (unbound).

This is the thesis for the doctorate degree written by Mr. J. L. DE VILMORIN, who of course is a member of the famous house which has been interested in the production of sugar beet seed since when in 1775 a member of the family introduced the plant from Silesia into France. It has chapers on the wild beet; hybrid forms; origin of cultivated varieties; theories relative to heredity in the beet; and is very fully illustrated with several coloured plates and numerous photographs. In the fourth chapter, in discussing the progress which has been achieved so far in improving the beet, the author quoted Munerati's opinion to the effect that there has hardly been any appreciable improvement during recent years in the beet selection establishments; but he also give figures communicated by Mr. SAILLARD showing the sucrose per cent., yield of roots per hectare, and yield of sugar per hectare during the past 18 years, from which data he draws the conclusion that they indicate (so far as France is concerned) an improvement that is quite encouraging. He does not, however, express any definite view as to whether much improvement beyond the average results of the present day may be expected.

Report for 1921 and 1922 of the Rothamsted Experimental Station. (Lawes Agricultural Trust, Harpenden, Herts.) 1923. Price: 2s. 6d., postage extra.

Problems which on the technical side are under investigation at Rothamsted fall into three groups, concerned respectively with the cultivation of the soil, the feeding of the crops, and the maintenance of healthy conditions of plant growth. Sir EDWARD RUSSELL, Director of the Station, here reviews the work which has been conducted during the years 1921 and 1922, and is still being continued for the purpose of the elucidation of such problems. It is possible, however, to mention here briefly only the subjects which have claimed attention. Dr. B. A. KEEN (Physical Laboratory) is examining the effect produced by cultivation processes, especially those concerned with tilth, water supply, and resistance to the passage of implements. Mr. E. M. CROWTHER in the same department is engaged on the determination of the acidity of the soil, using the electrometric method. Dr. WINIFRED E. BRENCHLEY and Miss K. WARINGTON (Botanical Laboratory) are concerned with the question of the substances which in small amounts affect the growth of the plant, and the latter investigator has shown that unless a certain small quantity of boric acid is present in addition to the so-called "complete" plant food, some leguminous plants die prematurely. Mr. H. J. PAGE (Chemical Laboratory) is carrying on work on the value of various fertilizers, including the new nitrogenous manures. Messrs. H. G. THORNTON and P. H. H. GRAY (Bacteriological Laboratory) are continuing the very interesting line of study initiated at Rothamsted of the control of the population of micro-organisms in the soil, while other departments are active in research on entomological, mycological, insecticide and fungicide questions. All interested in plant growth and soil conditions follow closely the work carried on at Rothamsted, and this Report for 1921 and 1922 records the results of investigations which are hardly less valuable and suggestive than in former years.

Laboratory Manual of Colloid Chemistry. By Harry N. Holmes, of Oberlin College, U.S.A. (Chapman & Hall, London.) 1923. Price 10s. nett.

General interest in the subject of colloid chemistry grows apace, and chemists in many industries (including our own) are recognising that many of the problems with which they are faced must be attacked in the light of this interesting development of science. There are now theoretical works in plenty on the subject, but the literature on laboratory methods is still rather scanty. This is the most thorough work on the practical side with which so far we have become acquainted. It records details of a large number of well chosen and clearly described experiments on the most important bearings of the subject, *e.g.*, suspensions; dialysis and diffusion; preparation of colloids; coagulation; protective colloids; surface tension; emulsions; viscosity; adsorption from solution; adsorption of gases; reactions in gels; and the use of the ultramicroscope. An interesting chapter is that on adsorption from solution. Here the Freundlich equation is stated and explained, and experiments are described for obtaining data for the plotting of curves illustrating its principle. Under the heading of "Special Topics," experiments are detailed which bear particularly on certain industrial problems arising in lubrication, in dyeing, and in the manufacture of rubber, leather, etc.; and there is a chapter devoted solely to "Soils and Clays," demonstrating the fact that the productivity of soil is closely connected with its colloid content. To some extent the book is a self-teaching manual, since it offers a large amount of material in the way of explanation and comment. It is one which should well meet the requirements of students in the colloidal laboratory.

Regarding the new Luabo (Zambesi) factory, the erection of which was announced at the last annual meeting of Sena Sugar Estates, Ltd.,[1] the centrifugal installation was supplied by Messrs. Pott, Cassels & Williamson, of Motherwell, Scotland. It consists of twenty-four 36 in. machines, belt-driven.

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[1] *I.S.J.*, 1924, 5.

Review of Current Technical Literature.[1]

CLARIFICATION OF SUGAR PRODUCTS PRIOR TO THE DETERMINATION OF THE REDUCING SUGARS. ***Lewis Eynon and J. Henry Lane.*** *Journal of the Society of Chemical Industry, 1923, 42, No. 49, 463-466T.*

Experiments were made to determine whether, in the process of precipitating lead with various agents from solutions of reducing sugars to which neutral lead acetate had previously been added, any precipitation or entrainment of reducing sugars occurs, the invert sugar being determined by the volumetric method recently described in which methylene blue is used as internal indicator.[2] Results were obtained showing that none of the following de-leading agents causes any precipitation of invert sugar with the lead precipitate: potassium oxalate, sodium sulphate, disodium phosphate, monosodium phosphate, and sodium carbonate. A second matter investigated was whether non-sugar substances, precipitable by neutral lead acetate can, when precipitated by this reagent from solutions of reducing sugars, precipitate or entrain the latter, the non-sugar substances used being tannic acid, egg albumin, and the non-sugars of cane and beet molasses. The results of these tests afforded the strongest evidence that no reducing sugars are carried down, either in the process of clarification with neutral lead acetate, or in the subsequent operation of de-leading with potassium oxalate. A. H. BRYAN[3] made a statement to the contrary, namely, that if a solution of dextrose containing magnesium sulphate and ammonium tartrate is treated with normal lead acetate (the excess of which is removed with potassium oxalate) about 0·9 per cent. of the reducing sugar is eliminated; but on repeating these tests the authors found that no precipitation of dextrose occurs.

A third question examined concerned the use of clarified and unclarified solutions when determining the reducing sugars in raw sugars and molasses. Any difference between the results obtained in this way will be due to two causes, viz., the removal of reducing non-sugar substances by the lead salt, and to the removal of calcium by the potassium oxalate used for precipitating the lead. In the unclarified solution, the errors due to reducing non-sugar substances and to calcium salts will affect the results in opposite directions, the resultant effect depending on the nature of the product under examination. Determinations were, therefore, made of the invert sugar content of various raw sugars and molasses, using (*1*) the untreated solution, (*2*) the solution after de-calcification with potassium oxalate, and (*3*) the solution after clarification with neutral lead acetate and removal of the lead and calcium with potassium oxalate. Comparison of the results tabulated showed that clarification with normal lead acetate did undoubtedly cause precipitation of some reducing substance; but this was not invert sugar, as was proved by fermenting away the invert sugar, and examining the reducing power of the residue obtained after eliminating the alcohol. In the case of raw sugars, treatment of the solution with neutral lead acetate and potassium oxalate generally had very little effect on the value found for reducing sugar; and, as a rule, unless the solution is so dark as to render obscure the end-point of the titration, a sufficiently accurate result is obtained with the untreated solution. With regard to molasses, it was evident that the net effect of clarification with neutral lead acetate followed by potassium oxalate, though rather small, is quite appreciable (amounting to 0·2 or 0·3 per cent. in two of the five cases examined). Since the partial bleaching effect of the solution thereby affected much facilitates recognition of the end-point in the volumetric method, it is certainly advisable to use a clarified solution for the determination of reducing sugars, the following being the procedure recommended: 12·5 grms. of the sample of molasses or other low product is dissolved in water, treated with 25 c.c. of a 10 per cent. solution of neutral lead acetate (and with a little alumina cream, if necessary), and made up to 250 c.c., the whole being thoroughly shaken and filtered: 100 c.c. of the filtrate is treated with 10 c.c. of a 10 per cent. solution of potassium oxalate, made up to 500 c.c., shaken and filtered, this 1 per cent. solution being used for the determination of the invert sugar by titrating it against

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

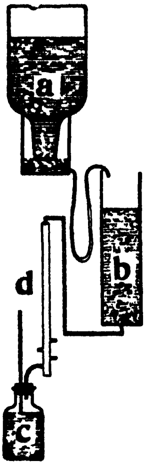
[2] *I.S.J.*, 1923, 143.

[3] *Bulletin No. 116, U.S. Bureau of Chemistry, 1908.*

10 c.c. of Fehling's solution with methylene blue as internal indicator. For the total sugars, 100 c.c. is inverted with dilute hydrochloric acid, neutralized, made up to 200 c.c., and the liquid (now a 0·5 per cent. solution of the sample) titrated against 25 c.c. of Fehling's solution, the sucrose content being calculated from the difference between the invert sugar contents before and after inversion.

Laboratory Apparatus for carrying out Tests with Animal Charcoal (Boneblack). W. D. Horne and E. W. Rose. *Industrial and Engineering Chemistry, 1923, 15, No. 12, 1270.*

A description of an automatic laboratory char filter was briefly stated recently[1] but details of its construction are now available, and are as follows: Its central feature is a set of filter-tubes *b* held in a vertical position in a water-bath, narrow piping, provided with cocks, passing from the bottom of these char tubes. Feeding is accomplished by a cylindrical container in the top of which is an inverted bottle *a* containing the sugar solution, which arrangement provides a reasonably constant head of the liquid in the cylinder, since the solution flows into the cylinder until it rises high enough to close the end of the feed tube, after which the level is automatically controlled to within 1·5 mm. when the bottle is nearly full, and to within 5 mm. when it is nearly empty. From the bottom of the cylinder runs a small rubber feed-pipe connected to fine copper tubing, 35 mm. long and 1·5 mm. internal diameter, forming a goose-neck, the top level of which is carefully set in reference to the level of the liquid in the cylinder, so as to give the required hydrostatic head and rate of flow, while from the goose-neck the solution drips very slowly into a piece of glass tubing leading into the filter-tube. Lastly, there is the distributor *d*, which passes the filtrate from the char into bottles, *c*. After the liquid dripping from *a* has filled up the tube to a point a little above the level of the char, the filtrate begins to overflow through an external tube and goose-neck into the distributor *d*. This is a brass tube about 30 cm. long and of 6 mm. internal diameter, attached vertically by a clamp to the outside of the water-bath holding the filter-tubes. It has at its lower end a series of short metal tubes (1·5 mm. diam.) radiating from it at differences in height of about 1 cm., and the filtrate dripping into the brass tube flows slowly out of the lowest of the radiating tubes into a 100 c.c. bottle. The neck of this bottle is closed by a stopper through which passes: (1) A fine brass tube connecting to the lowest radiating tube, and (2) a vertical brass tube, 10 cm. long, the lower end of which stands at the level at which the filtrate is to be stopped. When the first collecting bottle becomes full, the filtrate from the char collects in the vertical brass distributing tube until its level rises 1 cm., when it begins to flow into the second collecting bottle, which operation continues through the cycle of as many bottles as may be desired.



The Polarimeter and its Practical Applications. C. A. Skinner.[2] *Journal of the Franklin Institute, 1923, 196, No. 6, 721-750.*

Contents of this article (unsuitable for abstracting here) are as follows: I. Introductory (distinction between azimuth, elliptic, and general polarimeters). II. Fundamental Facts and Relations (vibration of light; propagation of light; and mechanical theory of propagation of elastic waves). III. Polarizers and Analyzers (Nicol, Glan, Glan-Thompson, Feussner, Ahrens, and Wollaston prisms). IV. Retardation Plates and Compensators (methods of producing a given ellipticity). V. Azimuth Polarimeters (Lippich and Cornu-Jellet Systems). VI. Applications of the Azimuth Polarimeter (saccharimetry, photometry, colorimetry, and pyrometry). VII. Elliptic Polarimeters (elliptic compensators, and elliptic half-shades). VIII. A General Polarimeter (Tool's azimuth and elliptic half-shade combination). IX. A Universal Polarimeter (capable of conversion into a Brace elliptic polarimeter, or into a azimuth polarimeter for rectilinear vibrations). X. Applications of the General Polarimeter (determining the optical constants of absorbing media, mechanical strass analysis, optical homogeneity of glass, etc.).

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[1] *I.S.J.*, 1923, 593.

[2] Chief, Optics Division, Bureau of Standards, Washington, D.C.

Repeated Use of Invertase in Hydrolysing Sucrose (Juices, Syrups, and Molasses for the Preparation of Table Syrup, or Artificial Honey). *Erich K. O. Schmidt. Vereinszeitschrift, 1923, 440-442.*

It is known that one can invert any quantity of sucrose with a small amount of the enzyme invertase (present in yeast, and in many micro-organisms), though the time required in so doing becomes very great. In order to reduce this time factor, one must therefore use a greater amount of the enzyme, which increases the cost of the process in commercial application, and thereby compels consideration of the possibility of the repeated use of the invertase. Investigations along this line have been carried out by the author at the Institut für Zuckerindustrie, in Berlin, and the results so far achieved by him may be summarized as follows :—The same amount of yeast can be used repeatedly for inversion at 50–55°C. without the occurrence of fermentation, a small diminution of the inverting power thus occurring, the separation being effected by filtration, and other batches of the liquor passed through the layer of yeast remaining on the filtering surface. An attempt was made to adsorb the invertase by means of heated charcoal so as to permit of its re-use, but this was not found possible, a mechanical mixture only resulting. However, by adding a solution of invertase to one of gelatin, allowing the liquid to set, and drying the mass obtained, a product resulted which could be used repeatedly, though only 20 per cent. of the invertase employed remained active. Further, by hardening the gelatin with formaldehyde, an invertase-gelatin preparation was obtained which could be used at 55°C. at least 11 times without diminution of its inverting power, but in this case only 5-7 per cent. of the invertase originally used had remained active.

Determination of Dextrose in Mixtures of Dextrose and Levulose. *Franz Lucius. Zeitsch. Unters. Nahr. Genussm., 1923, 46, 94.*

A method worked out by the author for determining dextrose in the presence of levulose depends on the destruction of the rotation of the latter by heating with dilute hydrochloric acid, that of the dextrose not being affected under the conditions prescribed. Details of the method were described a few years ago, but now the strength of the acid, and the time of heating, have been so modified as to complete the reaction more quickly, the procedure recommended being as follows :—50 c.c. of the sugar solution are heated in a 100 c.c. flask with 20 c.c. of 5 *N* hydrochloric acid for 3 hours in a boiling water-bath ; cooled ; 5 *N* sodium hydroxide added till the liquid is only faintly acid ; made up to 100 c.c. ; filtered ; treated with animal charcoal in the cold ; and polarized in a 200 mm. tube at 20°C. This reading represents the dextrose, so that the levulose is given by the difference in the polarimetric reading before and after the treatment.

Colloidal Cane Juice Clarification, using Aluminium Silicate. *Clifton H. Wells. La. Planter, 1924, 71, No. 20, 394-395.*

Noël Deerr[1] has found that the colloids of cane juice are negatively charged. F. R. Bachler, therefore, reasons that it should be possible to neutralize the negative charge by adding a positively charged colloid, and thus effect the precipitation of these colloids, hydrated aluminium silicate being recommended by him as a precipitant of suitable properties. It is quite insoluble in sugar solutions ; it remains in the colloidal state no matter to what extent it is diluted with water ; and it can be flocculated by the addition of suitable electrolytes. Laboratory experiments to ascertain its value for the clarification of cane juices and syrups have been carried out by the author in a Mexican factory with the most encouraging results, it is stated. Mill juice was treated in the cold with quantities of the colloid varying from 1 to 7 grms. per litre, heated to boiling, and allowed to subside, rapid settling with the production of a brilliantly clear liquid being the result. Two grms. per litre was found to be the best amount to use. Later it was decided that treatment with the colloid alone would not be a practical process, since the juice would remain sufficiently acid to undergo inversion in its subsequent stages, so the method adopted was to mix the cold juice with 3 grms. of the colloid per litre, lime almost to neutrality, heat, and subside, when the following analytical results were obtained:—

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[1] *I.S.J.*, 1916, 502.

	Brix.	Purity.	Acidity.	Rate of Settling, Mins.	Colour.
Original raw juice	13·91	83·31	19·0	—	—
Clarified with lime only	14·55	85·23	2·3	10	79
Clarified with colloid and lime	14·31	85·27	4·3	14	62

Although the rate of settling was slightly lower in the case of the colloid-and-lime clarification, a brilliantly clear juice which filtered more rapidly and had a lighter colour was obtained. Furthermore, the syrups obtained by concentrating the colloid-and-lime treated juices always filtered rapidly, giving brilliantly clear syrups of much lighter colour than were obtained in the factory by means of the Bach syrup sulphitation process; so that in the author's opinion it should be possible to obtain by this method of colloid clarification a very high-grade syrup requiring only to be mixed with a little kieselguhr previous to being filtered through cloth for boiling to grain in white sugar manufacture. Another point noticed was that by means of the hydrated aluminium silicate about 15 per cent. of the lime salts were removed from the juice, so with the reduction both of the gums and of the lime salts the result should presumably be a molasses of somewhat lower purity than in ordinary work. Lastly, it is incidentially remarked, that if this clarifying process is capable of being applied in the factory with the satisfactory results which these laboratory tests appear to predict, then it would probably make the use of continuous clarifiers, Dorr "thickeners," and like apparatus, a success by enabling them to deliver a perfectly clear juice under constant conditions of operation.

CUBAN CHEMICAL CONTROL DATA COMPARED WITH JAVAN. (1) *H. C. Prinsen Geerligs. De Indische Mercuur, 46, No. 33,* August 17th, 1923. (2) *Anon. Facts about Sugar, 1924, 17, 367.*

Cuba has now put into operation a system of "mutual chemical control" on much the same lines as has been carried on in Java since 1899 and in Hawaii since 1907, according to which the several factories send the figures obtained by their chemists to a central bureau, where they are collated, and later distributed for comparison. Among the 182 factories now in Cuba, 71 took part in this scheme last season, and on receiving copies of the control sheets, Dr. GEERLIGS took the opportunity of comparing the figures with those for Java, as averaged during the past 10 years.

	Cuba, 1923.	Java, 10-year Average.
Sucrose:		
Sucrose in the cane	13·17	12·65
Extraction	92·00	92·05
Purity, normal juice	82·65	83·70
Sugar of 96° polarization:		
Per cent. of cane	11·70	10·66
Per cent. sugar in cane	86·42	84·73
Per cent. sugar in juice	94·72	91·74
Sugar lost per cent. cane in:		
Bagasse	1·06	1·04
Filter press-cake	0·67	0·10
Molasses	0·86	0·98
Undetermined	0·08	0·30
Total	2·28	2·41
Purity of final molasses	33·01	32·49

It is therefore seen that the sucrose content of the cane is higher for Cuba; that the extraction is about the same for both; and that the sugar lost in the filter-press cake and in the molasses is higher in Cuba than in Java. It is pointed out in the second article referred to above that examination of the complete figures of the Cuban control shows that the purer the cane juice, the more sugar is left in the final molasses, as may be demonstrated by grouping the factories in order of the sucrose content of the cane; averaging the purity of the juice from each group; and plotting these purity figures against the average purity of the molasses of the same group.

Formation of Gum Levan in Sucrose Solutions. *W. L. Owen. Journal of Bacteriology, 1923, 8, 421-445.*

It is pointed out that the ability of bacteria of the so-called potato group, especially *B. vulgatus*, to cause the gummy fermentation of sucrose solution is an acquired characteristic,[1] the acquisition of which may be promoted by the conditions existing in and around a sugar factory. Thus, particles of soil adhere to the cane or beets, and introduce the spores into the juice, where the bacilli undergo a cycle of development. A proportion of them is separated with the press-cake, which on being returned to the soil introduces a new generation into the factory with the next crop, which cycle is repeated, each time with an increased power of gum formation. These organisms are able to grow in sucrose solutions with a concentration as high as 60 per cent., and their spores are very resistant to high temperatures. They are more likely to develop in limed than in raw or sulphited juices, their optimum hydrogen-ion concentration being between 6·7 and 7·0.

Simple Device for the Production of a Sodium Flame for Use with Polarimeters. *Jacob Dolid. Industrial and Engineering Chemistry, 1924, 16, No. 1, 53.*

A tube of asbestos paper is wrapped loosely round the tube of a bunsen burner, and then, by means of a rubber stopper a piece of glass tube of wider diameter than the asbestos tube is fixed in position, the space between the asbestos and the glass tubes being filled with sodium chloride solution, which thus saturates the asbestos. On adjusting the asbestos tube so that its top comes into contact with the flame, a steady and bright sodium light can be obtained, which may be maintained as long as there is salt solution in the reservoir.

Determination of the Ash of Sugar Products, using Nickel Dishes *Wm. L. O. Whaley. Facts about Sugar, 1924, 18, No. 3, 64-65.*

In this article are given in full the particulars of the experiments which have already been summarized in these columns[2] relating to the advantages of using nickel dishes for ash determinations, as compared with those made of platinum or silica.

Comparative Experiments on the Stands of the Sugar Beets. *Fr. Chmelar and Jar. Simon. Zeitsch. Zuckerind., Czecho-slovak. Republik, 1923, 47, Nos. 48-51, 671-677, 683-694, and 707-711.*

Until about 15 years ago, it was accepted that rows 40 to 50 cms. (16 to 18 in.) apart with the roots 20 to 25 cms. (8 to 10 in.) from one another in the rows constituted the best density in cultivation; but during that period selection has raised the sucrose content, yield, and quality of the beet to a higher degree, so that it appears doubtful whether these conditions still hold. Hence the authors have carried out a good number of comparative field trials with two well-known varieties, viz., Dobrovice and Schreiber, much grown in Czecho-Slovakia; and their principal conclusions are as follows: So far as the yield of sugar per unit of area is concerned, no change from the stands hitherto accepted requires to be made. In regard to the total weight of the crop of roots, this increases when the distance between the rows, or the space apart in the rows, is increased from 40 to 60 cms. (16 to 24 in.) or from 25 to 30 cms. (10 to 12 in.). If the area occupied by the plant is increased by 12·5, 25, and 50 per cent., then the weight of the root harvested is increased 9 to 15, 11 to 20, and 28 to 36 per cent. respectively. As the distance between the rows is increased, the sugar content of the root is diminished though inconsiderably up to 50 cms. (10 in), but beyond this distance the decrease is more marked.

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[1] Compare *I.S.J.*, 1922, 663.   [2] *I.S.J.*, 1923, 329.

WATER REQUIRED FOR SWEETENING-OFF PRESS SCUM IN KELLY AND OTHER FILTERS. *A. Schweizer, T. van der Linden, and others.* *Archief; Verslag der Vergaderingen van de Vereeniging van Adviseurs bij de Java-Suikerindustrie, 1923, 4e deel, 4e afl., 160-161.*

At the recent Conference of Advisers to Java sugar factories (technical and chemical sections) some figures were contributed by Mr. SCHWEIZER relative to the amount of water necessary for sweetening-off scums in Kelly and Kroog presses. Thus, the piculs of water present in the thin-juice per picul of insoluble dry substance in the scums were 5·2 and 3·2 for the two filters in the order named; while for the mixed juice lost per 100 of insoluble dry substance in the filter scum the values were 47·0 and 28 7 respectively, which figures were calculated by the H.V.A. method. Similar results, though somewhat less favourable, were contributed by Dr. VAN DER LINDEN.

TIME FOR TESTING MOTHER BEETS. *Dean A. Pack.*[1] *Journal of Agricultural Research, 1923, 26, No. 3, 125-150.*

Figures are given demonstrating the contention that, in order to understand clearly the comparative value of different strains of beets, the plant breeder should record both fall and spring tests, and should state the conditions under which the beets were stored.

FUTURE OF VEGETABLE DECOLORIZING CARBONS IN THE REFINING OF SUGARS. *B. Sanderson.* *La. Planter, 1923, 70, No. 22, 473.*

Some of this writer's remarks are to the following effect: The cost of making a good raw product is not greater than producing an inferior one, and it is really cheaper to shid a 97° sugar into the U.S.A. and refine it there than to ship and refine sugars with a lower content of sucrose. With the aid of common-sense clarification and modern apparatus, there is no trouble in producing 97° sugar; in fact it is being done already, and the demand will be made mandatory later. Further there is no reason why the colour of a high-grade raw sugar should be spoiled, and the time is near when the sugar imported to the U.S.A. will have a purity of 98° and a colour at least equal to that of Louisiana sugar. It will then require but a small quantity of water to wash it, and the washed crystals will be nearly white. When this has been accomplished, vegetable carbons are bound to come into their own. As things are at present, it takes a very heavy armament to fight a foe of many impurities, and to overcome a tenacious dark colouring matter, which not only surrounds the crystals but discolours them through and through. In the future, not only will the amount of the impurities accompanying the crystals be diminished, but the grain itself will be of a light colour. Then the "heavy armament" in the shape of an array of char filters can be scrapped to be replaced by a very simple outfit, bone char giving place to highly active vegetable carbon requiring only a modest equipment for the operation of refining.

DETERMINATION OF PECTIN IN VEGETABLE PRODUCTS. *H. J. Wichmann.* *Journal of the Association of Agricultural Chemists, 1923, 7, No. 2, 107-112.*

Accurate results are given by the Carré-Haynes method[2] only when great care is used in the washing of the precipitate. There is a tendency towards high results, owing to the difficulty of removing calcium chloride from the colloidal precipitate. Limited quantities of sugar, tartaric, citric, and phosphoric acids do not cause high results under the conditions of the method. Calcium pectate and the pectic acid of WICHMANN and CHERNOFF[3] do not correspond in composition. There is some evidence that calcium pectate is a mixture, and if not a mixture it is an intermediate compound between pectin and pectic acid.

J. P. O.

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[1] Plant Breeder, Sugar-Plant Investigations, Bureau of Plant Industry, U.S. Department of Agriculture, Salt Lake City, Utah.

[2] *I.S.J.*, 1923, 631.

[3] *J. Assoc. Official Agric. Chemists*, 1922, 6, 34-35.

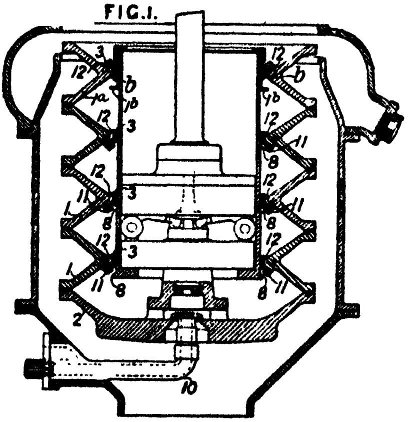
Review of Recent Patents.[1]

UNITED KINGDOM.

Continuous Centrifugal Separator. *Wilhelm Mauss*, of Johannesburg, Union of South Africa. *205,850.* June 26th, 1922.

This is an improvement in continuously rotating separators of the kind described in two previous specifications.[2] According to the modification, the baffles are arranged on the sides of the peaks, nearest to the feed inlet. Further, the overflow lip on the top chamber is at a less radial distance from the axis of the machine than the peaks of the lower chambers. This construction presents advantages in the retaining of solids by the baffles, providing a greater radial depth of liquor and a slower flow over the peaks when the machine is in operation. It also presents advantages when the apparatus is used in the displacement process described in the second specification in the footnote, in which any liquor in the chambers is washed out by means of a liquid of lighter specific gravity. Owing to the improved arrangement of the baffles, the displacing liquid enters practically at the smallest distance possible from the axis of the machine, flows on the inner surface of the liquid under treatment, and displaces same to or a little beyond the outer lip of the baffle, so that if the displacing liquid is carefully regulated the dilution of the total separated liquor at the top overflow or discharge point of the machine is practically *nil*. A further feature consists in the method of mounting the drum sections and the baffles. In this method, the top baffle ring and the top drum section are fixed to a cylinder which is slidably mounted on a central driving shaft and operated by means of toggle mechanism. The remaining baffle rings each carry a drum section and are freely slidable on the cylinder, the cylinder being of different diameter for each ring and having a shoulder formed thereon adapted to raise the baffle and drum section when said cylinder is raised. The drum is closed by a fixed bottom section. The shoulders on the cylinder are so spaced and arranged as to raise the baffle rings and drum sections to cause an opening of the drum sections when the cylinder is raised by the toggle mechanism. The baffles are in the form of solid rings or discs having bosses thereon which form openings between the peaks of the drum sections and the baffles so that no liquor can pass under any circumstances except by flowing over the peripheries of the baffles. The drum is mounted in a receiver having a discharge outlet for solids and also an outlet for the separated liquor as in the specifications above referred to.

FIG. 1.



Referring to the drawing, it is seen that the baffle rings *3* are arranged on the sides of the peaks between the chambers of the drum nearest the feed inlet *10*, and the overflow lip *b* of the top drum section *1a* is at a less radial distance from the axis of the machine than the peaks of the sections *1*. The device for separating the sections to allow discharge of the solid matter consists of a cylinder to which the top section *1a* is attached, and which is provided with a series of shoulders *8* adapted to raise the sections *1* successively away from each other and the fixed bottom section *2*. The baffle rings *3* are secured to the sections by bolts *11* passing through bosses which leave passages *12* between the baffle rings and the section. A separate baffle ring *1b* may be attached to the cylinder below the top ring.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] U.K. Patent, 164,418; *I.S.J.*, 1921, 592: and 182,856; *I.S.J.*, 1922, 609.

Alcohol Motor Fuel. *G. Scaravelli*, of Turin, Italy. *206,147.* October 23rd, 1923; convention date, October 25th, 1922.

Motor spirit is obtained by mixing ether or amyl acetate or acetone with methylated spirit and kerosene, or by treating a mixture of methylated spirit and kerosene with lime and sulphuric acid; 5-10 per cent. of castor oil may be added to lubricate the engine.

Manufacture of Alcohol Fuel. *Soc. Ricard, Allenet & Cie.*, of Melle, Deux Sèvres, France. (*A*) *204,697.* September 14th, 1923; convention date, September 30th, 1922. (*B*) *206,516.* November 5th, 1923; convention date, November 4th, 1922.

(*A*) Mixtures of alcohol with gasolene, petroleum, benzene, etc., are dehydrated, and consequently stabilized for use as fuels, by a continuous process comprising passage through water-absorbing substances (e.g., potassium carbonate, sodium carbonate, calcium carbide, preferably mixed with inert material as coke, asbestos or granular pumice to prevent clogging). A small quantity of ether, benzene, xylene, butylic alcohol, isopropyl alcohol, or other liquid rendering the aqueous alcohol and the hydrocarbon fuel miscible with each other may be added before passage through the towers. (*B*) Mixtures of alcohol and a liquid hydrocarbon are dehydrated, and so made stable by treating them with a harmless desiccant practically insoluble in either liquid. Preferably a small proportion of a liquid rendering the alcohol and hydrocarbon mutually miscible is added before dehydration. Liquid "combining" agents specified are ether, benzene and its homologues, propyl, butyl, and amyl alcohols, and their homologues, and cyclohexanol. Suitable desiccants are potassium carbonate, sodium carbonate, sodium sulphate, copper sulphate, magnesium chloride, and magnesium sulphate. In an example a mixture of 80 litres of petrol, 20 litres of 95 per cent. alcohol, and 2 litres of ether is passed through a series of six vessels charged with potassium carbonate mixed with inert material such as pumice, the strength of the alcohol being thus raised to 98·7 per cent.

Polarimeters. *M. L. A. Jobin and G. G. J. Yvon*, of rue Humboldt, Paris. *204,693.* September 11th, 1923; convention date, October 2nd, 1922.

This invention comprises an arrangement of apparatus mounted on a common base plate which may be used as a photometer for testing absorption or diffusion, or as a polarimeter. Provision is made for the use of monochromatic, ordinary or polarized light. In the majority of the arrangements of the apparatus disclosed in the specification, use is made of a Lummer-Brodhun photometric cube, the central portion of the field of which is a reflecting surface, and the outer portions transparent surfaces. The outer portions are illuminated by a direct beam of light and the central portion by a beam at right angle to the direct beam, which has passed through the material under test. Both beams are parallel when passing through the cube and are observed by a collimating telescope.

Prisms for Dipping Refractometers. *Carl Zeiss*, of Jena, Germany. *204,666.* August 16th, 1923; convention date, October 7th, 1922.

In order to increase the range of dipping refractometers, they are provided with a number of inter-changeable prisms; but in inter-changing these prisms the slightest error in laying a prism against the respective stop of the refractometer tube produces a deviation of the zero point of the scale in the field of view of the telescope. It is therefore necessary to control the adjustment by making trial measurements with suitable liquids e.g. water, or special solutions. According to the invention, it is possible to avoid this by providing the instrument with a special modification of the respective prisms in such a way that their surfaces, which are to face the telescope, consist of two parts inclined to each other.

Charcoal and By-products.[1] *Stanley Hiller*, of San José, Cal., U.S.A. *206,245.* August 3rd, 1922.

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[1] U. S. Patent, 1,458,410; *I.S.J.*, 1923, 503.

UNITED STATES.

Hydraulic Pressure Gear for Mill Rollers. *Guy C. Mitchell* (assignor to the *Hooven, Owens, Rentschler Co.*, of Hamilton, Ohio, U.S.A.). *1,461,135.* July 10th, 1923. (Two figures: four claims.)

In the drawing, *10* designates the upper portion of the mill housing, which supports a lower bearing member *11* having a lining *12* of any suitable material. Co-operating with the lower bearing member is an upper bearing member *13*, the roll shaft *14* being journaled between said bearing members. Mounted upon the upper end of the housing *10* is the top cap *20*, which is held in properly assembled position upon the housing by means of king bolts *21*, the lower ends of which are suitably attached to the housing; and the upper ends, which pass through ported plates *22* co-operating with the top cap *20*, are threaded. Suitable nuts *23* are threadedly mounted on the upper ends of these bolts, for drawing the top cap tightly upon the roll housing. The top cap *20* has centrally formed therein a cylinder aperture which has a lower zone *25* and an upper zone *26* of greater diameter than the lower zone; the cylinder aperture, because of these two zones of different diameter, having a shoulder *27* substantially midway of its length. Preferably the lower zone *25* is provided with a removable lining *28*, of suitable material, which may be readily replaced if excessive wear occurs during operation of the device. When such a lining is used its upper end preferably terminates in such position as to constitute in effect a part, or continuation, of the shoulder *27*. Adjacent its lower end, the lower zone *25* is provided with an inturned shoulder *29*. Mounted within the lower zone *25* is a lower plunger *35*, the lower part of which extends through the aperture defined by the shoulder *29* and bears against a toe plate *36* which in turn bears against the pressure plate *37*. The pressure plate *37* co-operates with the upper bearing member *13*, a gasket *38* preferably being interposed between these members. The lower plunger has a shoulder thereon adapted to co-operate with the shoulder *29* to limit movement of the plunger toward the pressure member; that is, its movement in one direction is limited, thus preventing the exerting of excessive pressure on the bearing members. Within the cylinder aperture is an upper plunger *40*, which has its lower part adapted for location within the lower zone *25*, and its upper part adapted for location within the upper zone *26*, the plunger being thus provided, in effect, with a shoulder *41* adapted to co-operate with the shoulder *27* to limit movement of the plunger in a downward direction. Carried by the wall of the upper zone of the cylinder aperture are a plurality of space locking lugs *45*, the diameter of the passage between opposing lugs being greater than the greatest diameter of the lower plunger *35*, the upper plunger *40* and the lining member *28*, to permit of ready insertion, or removal of these parts from the cylinder aperture. Mounted within the upper zone *26* is a cross-block *46* having a plurality of lugs *47*, carried thereby, which lugs are adapted, when the cross-block is in one position, to pass through the spaces between the locking lugs *45*, and when turned into another position to co-operate with the

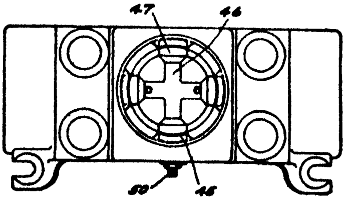


Fig. 2.

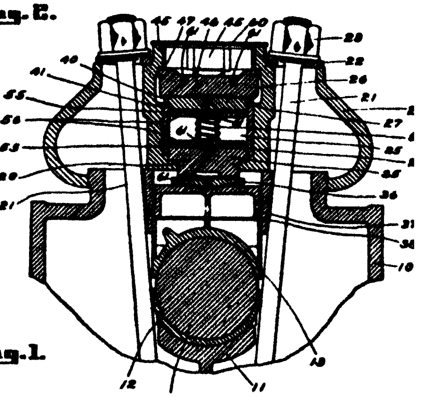


Fig. 1.

lower faces of the locking lugs to limit movement of the upper plunger *40* against movement in the other direction, that is away from the shoulder *27*.

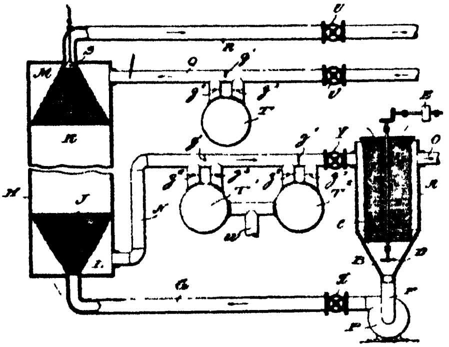
Opening into the cylinder aperture, between the upper and lower plungers is a pipe *50* through which any desired pressure fluid is introduced. The opposing faces of the upper and lower plungers, that is the faces which are subjected to the pressure fluid, are provided each with a suitable packing *55*, which packing is preferably in the form of a cup leather. Associated with each packing is a follower plate *56*, each plate being adapted to hold its co-operating packing in position, when the device is assembled. A spring *57* is located between the two follower plates, and holds these plates, with their co-operating packings against the plungers. This construction obviates the use of bolts, and corresponding holes in the packings, for holding these packings in position. A cover plate *60* is provided, which closes the upper end of the cylinder aperture. Threaded openings, designated generally by the numeral *61*, are provided in the various removable parts of the apparatus for receiving a suitable tool, to facilitate handling of these parts. This pressure regulating mechanism is adapted to permit movement of the roll carried upon the roll shaft *14*, relative to its co-operating roll or rolls, in order to allow passage of a varying quantity of material between these rolls, while maintaining constant the pressure exerted upon that material. The device, is therefore so arranged that movement of the lower plunger *35* toward the upper bearing member *13* is limited, although movement of this plunger in the opposite direction can take place if it is subjected to a pressure greater than exists within the cylinder aperture between two plungers, through the pipe *50*. The pressure fluid forces the upper plunger *40* against the cross-block *46*, and forces the lower plunger *35* against the stop shoulder *29*. As material passes between the roll, the upper roll will be lifted, carrying with it the upper bearing member *13*, the pressure plate *37* and the toe plate *36* into contact with the end of the lower plunger *35*. If more material passes between the rolls, thus tending to spread them apart, further movement of the roll can take place without any increase in pressure above that existing within the cylinder pressure.

APPARATUS FOR THE REVIVIFICATION OF DECOLORIZING CARBON, ANIMAL CHARCOAL (BONEBLACK). *Fred W. Manning* (assignor to the *Manning Refining Equipment Corporation*, of Delaware, U.S A.). *1,473,491.* November 6th, 1923. (Four figures; thirteen claims.)

Among the difficulties involved in the revivification of decolorizing carbon, animal charcoal (boneblack), and the like, are: Accurate control of temperature and oxidation; uniform treatment of the material; regular distribution of the heating and oxidizing gases; and prevention of mechanical loss. It is the purpose of this invention to provide a method and apparatus by which materials of the kind named may be rapidly and economically revivified, so that the temperatures at different periods of treatment may be modified and controlled and finely divided preparations may be treated without loss. To this end, the material is dropped through a narrow hot-walled chamber containing an atmosphere of appropriate composition, the particles being heated by radiation from the walls and by the gas mass, while falling. In so doing, though the materials are treated *en masse*, yet each individual particle of material is really individually heated and treated. The invention resides in heating and treating materials of the class described, for activation and revivification in a state of free fall. An externally heated, vertical retort or shaft through which the material is dropped is provided; and also sealed means for introducing the granular or pulverulent material into the top of the retort, and at the bottom for removing the material there accumulating. Suitable firing means are provided for heating the retort or shaft member. It is not desirable that any individual particle of the material under treatment should be very far from the hot wall of the retort; so the retort must be narrow in one diameter, although not necessarily so in others.

CONTINUOUS EXTRACTION OF JUICE FROM BEETS, ETC., BY DIFFUSION. *Walton C. Graham*, of Denver, Col., U.S.A. *1,437,801*; *1,467,849*. December 5th, 1922; September 11th, 1923.

Apparatus is described for the continuous extraction of juice from beet slices, according to which this material is carried along by a stream of liquid, and is acted upon in the treating chamber *H* (the top and bottom of which are made in the form of foraminous cones) by a stream of liquid moving in the opposite direction, being held in such a way as to be brought into intimate and uniform contact under pressure with the treating liquid and preventing from packing. Referring to the drawing in detail, *A* designates a hopper into which the sliced beets or cossettes are fed, having a conical bottom *B* and a lining *C* of woven wire or the like, spaced from the walls and a stirrer *D*. From the bottom of the hopper extends a conduit *F* to the pump *P* and from this extends a pipe *G* to the treating chamber *H*. This chamber is preferably cylindrical and is of comparatively great length or height relative to its diameter. It is arranged vertically, and the pipe *G* communicates with the bottom thereof. Inside at the top and bottom are cone-shaped foraminous partitions *J* and *K*, the large ends of these facing toward the middle of the chamber. Spaces *L* and *M* respectively are formed below and above; from the space *L* extends a pipe *N* back to the hopper *A* with which it communicates near its upper end; while a discharge pipe *O* also extends from the hopper *A* at substantially the same level as the pipe *N*. A pipe *Q* communicates with the upper space *M*, and is controlled by means of a valve *V*. Extending upwardly from the centre of the chamber *H* and partition *K* is a discharge pipe *R* controlled by a valve *U*, also by means of an adjustable bell *S*. Suitable heating means *T* is interposed in the pipe *Q*, and other heating means T^1 and T^2 in the pipe *N*, steam being supplied to the heaters by means of a pipe *W*, and valves Z^1, Z^2 and Z^3 governing the flow through said heaters. By this means any or all of the heaters may be used, and the temperature of the liquids thus controlled. Valves *X* and *Y* are interposed in the pipes *G* and *N* respectively for controlling the flow of material therethrough.



In operation, the hopper *A* is first filled to the overflow point *O*, either with fresh or saturated solvent, and the valves *X* and *Y* being open, the treating chamber *H* will likewise be filled with the said solvent to a height determined by the position of the overflow *O*, as will also the connecting lines *G* and *N* and the heaters T^1 and T^2. Finely divided beetroot is introduced into the hopper *A*, within the screen *C*, the pump and stirrer started; and the mixture of liquid and solids forced through the pipe *G* into the lower portion of the chamber *H*. Here the solid material collects above the screen, while the liquid passes through into the space *L*, and back by means of the pipe *N* through the heaters to the hopper *A*. This operation is continued until the entire space between the screens *J* and *K* is filled with a compact mass of material, compressed against the upper partition by the action of the pump *P*, the liquid meanwhile being continuously returned to the hopper *A*. Valves *X* and *Y* are temporarily closed, and the pump stopped. Fresh solvent or water, heated by passage through the heater *T* is now admitted through the pipe *Q* by opening the valve *V*. It enters the space *M*, where it percolates downward through the small interstitial spaces of the compact mass of material; the displaced air rises as the space is occupied by the liquid and passes out at the top through the pipe *R*, until finally the interstitial spaces within the chamber *H* are completely filled with the liquid. Next valve *Y* is opened, and a flow of liquid takes place from the top of the chamber to the bottom, by means of the pipe *N* into the hopper *A*, which being full, will cause the overflow of an equal amount of liquid through the pipe *O*. This flow through *H* should be continued until the soluble matter is exhausted to the desired extent. The system is now in readiness to begin continuous operations. Introduction of finely divided beetroot into hopper *A* is resumed, and carried on uninterruptedly, the valve *X* is opened, and pump and stirrer are set in motion with the result that, valve *Y* being also open, further amounts of a mixture of liquids and solids are continuously passed into the bottom of chamber *H*, where as before the solids are retained above the screen, while the liquid returns by gravity through the pipe *N* to hopper *A*. Each increment of solids displaces a corresponding quantity of exhausted material at the top of *H*, this being forced through the partly-open bell *S* and the pipe *R* out of the apparatus, the valve *U* being open. Introduction of fresh hot solvent through pipe *Q* is continued, and this progressively displaces the charged solvent, which escapes through pipe *N*, and eventually overflows at *O*. Solution is accomplished by the passage of the liquid introduced through pipe *Q*, and at the same time, the exhausted material is discharged through the pipe *R*. The solvent in its downward path comes in contact with material carrying increasingly greater amounts of soluble matter, while the solids in passing upward come in contact with solvent of continually decreased content. As the well saturated solvent passes out of the chamber *H* through the foraminous partition *J* by the line *N*, through the heaters T^1 and T^2, it comes finally in contact with fresh material in hopper *A* and basket *C*, where a further extraction of such soluble matter takes place.

MANUFACTURE OF DECOLORIZING CARBON FROM "ROTTED COAL." *Hugh Rodman and Earl E. Boren* (assignors to *Rodman Chemical Co.*, Pennsylvania, Pa., U.S.A.). *1,474,120.* November 13th, 1923.

By "rotted coal" is meant coal in those veins, which, ordinarily hard and normal, has deteriorated so that the characteristics of the original material have completely altered, having been converted into a laminated, friable substance, holding about 30 per cent. of water. It has been discovered[1] that when this "rotted coal" is highly heated and subsequently treated, it yields a char having valuable properties in respect of ability to decolorize liquids, including impure sugar solutions. Apparently there is some special merit in the use of this particular material, as the same results are by no means obtained from other well-known materials when subject to the same treatment under the same conditions. Ordinary coal, for example, gives an almost inert preparation. In regard to the method of operation, the inventors have produced on a commercial scale a char of the properties described by passing the raw, rotted coal through a rotary kiln heated to about 1800° F. (982° C.), and then blowing highly superheated steam through the carbonaceous matter for several hours while maintaining the temperature at the degree named in a closed vessel. They state that there appears to be no reason for doubting that the product may be manufactured commercially also by passing the rotted coal through a kiln, allowing the red-hot char to drop into a heat-insulated chamber, and there subjecting it to the action of highly superheated steam ; and there would seem to be enough fuel value in the volatile matter evolved to furnish the heat required, especially when it is considered that much hot water gas would be generated when working in this way. Activated char made by the inventors by the method described is stated to be better than any of the various materials on the market, while it may be regenerated after use to approximately its original power by simply passing it again through a red-hot kiln. If the small amount of ash present in the preparation is objectionable for certain purposes, it may be leached out by suitable chemical reagents, hydrochloric acid, for example, though this will be necessary, it is thought, only in special cases.

PREPARATION OF CANE AND SORGHUM (IN THE SMALL-SCALE PRODUCTION OF SUGAR OR SYRUP). *Edward Wessale*, of Waconia, Minn., U.S.A. *1,469,744 ; 1,474,870 ; 1,474,871.* October 2nd, 1923. November 20th, 1923.

These three specifications relate to apparatus for the removal of tops, leaves, sheaths and trash from cane or sorghum previous to crushing for the extraction of juice for the production of sugar or syrup, presumably on the small scale.

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[1] Compare also: U.S. Patent, 1,420,754.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to January 23rd	98,708	159,074
Deliveries ,, ,,	99,502	159,074
Meltings by Refiners ,, ,,	900,000	121,870
Exports of Refined ,, ,,	1,700	3,000
Importers' Stocks, January 23rd	—	—
Total Stocks, January 23rd	26,323	17,959
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1920-21. Tons.	1921-22. Tons	1922-23. Tons.
Exports	4,793	40,907	10,071
Stocks	11,978	36,871	22,162
	16,771	77,778	32,233
Local Consumption	—	—	—
Receipts at Port to December 31st	16,771	77,778	32,233

Havana, December 31st, 1923. J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to January 24th, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
Germany	Sept.-Jan.	1,125,000	1,463,000	1,305,810
Czecho-Slovakia	Sept.-Jan.	1,030,000	733,825	659,907
Austria	Sept.-Jan.	40,000	23,976	16,322
Hungary	Sept.-Jan.	110,000	81,603	74,898
France	Sept.-Jan.	488,000	490,360	306,073
Belgium	Sept.-Jan.	260,000	268,928	289,866
Holland	Sept.-Jan.	230,000	255,592	379,770
Russia (Ukraine, etc.)	Sept.-Jan.	250,000	193,400	49,374
Poland	Sept.-Jan.	378,600	294,269	179,096
Sweden	Sept.-Jan.	153,890	71,790	231,066
Denmark	Sept.-Jan.	110,000	88,382	146,800
Italy	Sept.-Jan.	311,450	261,607	217,532
Spain	Sept.-Jan.	190,000	160,035	72,257
Switzerland	Sept.-Jan.	5,500	8,000	5,856
Bulgaria	Sept.-Jan.	40,000	16,250	12,712
Rumania	Sept.-Jan.	80,000	49,872	25,761
Total in Europe		4,870,440	4,516,289	3,973,100

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th January, 1924.

Throughout the period under review the market, both for actual sugars and "paper," has been extremely firm. Prices have materially advanced and a very large business has been transacted.

The terminal market advanced at the highest point, about 5s. per cwt. 5000 tons was again tendered on January contracts, and the sugar was readily taken up and made no apparent impression on the market. Speculation, although to a slight degree becoming more interested, is still absent. Prices here followed closely the American market, which advanced in consequence of the American refiners' purchases. Large covering orders reached our market from the Continent as a result of their sales of refined. January sold from 30s. to 32s., March from 28s. 3d. to 33s. 6d., May 27s. 4½d. to 32s. 9d., August 27s. 1½d. to 30s. 9d. The feature has been in new crop, and a large business has been done at 23s. 6d. up to 26s. 6d. After the rapid improvement prices have fluctuated somewhat, and the latest quotations are February 34s., March 34s., May 33s. 3d., August 31s., October/December 26s. 3d.

Trading in actual sugars has been brisk, both for spot and forward. As both visible and invisible stocks are small the trade who have been adopting a hand-to-mouth policy, were forced again and again to enter the market and take all available offers. A certain section of the trade are beginning to change their ideas, and a fair business has been done in forward months up as far as June. The London refiners have made successive advances, and altogether their prices are 2s. 6d. per cwt. higher for spot, and 3s. 6d. per cwt. for forward. To-day's quotations are No. 1 Cubes 64s. 9d., London Granulated 62s. 7½d.

The refiners have continued to buy raws throughout the month of January and beginning of February, and their purchases have included Peru 96 per cent. 27s. 6d., Mauritius Crystals from 31s. 6d. to 33s. 6d. c.i.f., and Cuban 96 per cent. from 23s. 6d. to 28/6. Continental countries have also bought good quantities of Cuban 96 per cent. at advancing prices.

Foreign Refined has been in very active demand and a large business has been done. Spot Javas have been sold from 57s. 9d. to 59s. 9d. Fine Granulated on the spot sold freely from 58s. 9d. to 61s. Czecho Granulated sold for January/March and for re-opening of navigation on the Elbe from 29s. to 33s., and April/May from 28s. 6d. to 33s. 6d. Dutch Granulated ready sold from 31s. 3d. to 33s. 9d., and a very large business was done in April/June at 31s. 9d. Belgian Granulated has been in good demand and sold from 30s. 3d. to 33s. for ready delivery. May/June Javas advanced from 26s. 6d. to 29s., and June/July from 25s. 3d. to 28s. c.i.f. American Granulated has not yet come to parity and the latest quotation for this sugar is 35s. c.i.f. for March shipment.

The demand for refined in America has been very brisk. The refiners who were hoping that the pressure of the early Cubans could cause a decline could not cope with the demand from the trade without covering raws, and the market for Cubans was forced up by their purchases from 4½ cents to 5¾ cents at the highest point.

No further news has been received regarding either the Cuban or European crops. There are signs that the sowings in Europe for the 1924/1925 crop are likely to be largely increased.

As we are approaching the Budget period the question of the sugar duty in this country is a very frequent topic of conversation, and now that the Labour Government are in power it seems more than probable that the duty of 25s. 8d. will be substantially reduced next April.

21, Mincing Lane,
London, E.C. 3.
February 11th, 1924.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 303. MARCH, 1924. Vol. XXVI.

Notes and Comments.

The Government and Sugar.

A month or so of Labour Government in this country has shown that, under present conditions of Parliamentary representation there is no chance, nor is there any apparent desire on the part of the Prime Minister, for the extremists of the party to get their way. The other two opposition parties would see to it if they did. Actually, however, there has been no attempt at united opposition against the Government, if only because it is not practical politics to induce them to resign at so early a stage of their career. Instead, we have been treated to votes of censure where the Liberals have saved the Government from the Conservatives, and others where the Conservatives have come to their aid to save them from the Liberals. This form of manœuvre is not without its dangers since it is conceivable that a retrograde measure drawn up to satisfy free trade doctrinaires may be passed with the support of the Liberal party in the event of the Labour vote being unanimous.

Such a danger indeed appears to us to confront the question of the Imperial Economic Conference resolutions of last autumn which have to receive the approval of Parliament. It has been stated by the Prime Minister (provisionally and not finally, we trust) that he intended to leave the decision to the unfettered vote of the House of Commons. This means, of course, that the vast bulk of the Liberal party will vote against approval, and much depends on the attitude of the Prime Minister himself as to how far the Labour party do likewise. The Conservatives are of course pledged to carry out the resolutions which their own party helped to formulate. But we cannot think that the Prime Minister will lightly advise his followers to disown a set of measures that had the approval of the Dominions and Colonies and was drawn up with the definite intention of strengthening the bond of union between the mother country and the overseas parts of the Empire.

Another point that will shortly come up for settlement is the question of the sugar duties. Possibly before another issue of this journal is published, the 1924 Budget will have been produced. Mr, PHILIP SNOWDEN, the Chancellor of the Exchequer, is credited with a desire to abolish them *in toto*, but it seems hardly likely that he will get his way. The Prime Minister has not, so far as we are aware, expressed himself with regard to our colonial sugar industry, but he has done so with regard to home beet sugar interests and that sympathetically, so we do not anticipate he will leave them without some financial support. That the sugar duties may be reduced is another matter. Even Mr. Baldwin had virtually pledged himself to reduce them if he were returned to power. It seems likely, then, that the Labour Government will for their own reasons take at least a portion of the duty on sugar off. The glamour of a "free breakfast table" always dangles before them. But it is not certain that a reduction of the duty or even its complete abolition will benefit the consumer in the long run. Sugar production is still too far behind normal sugar consumption and likewise too much in the hands of Cuban-American interests for us in this country to be secure from market rigging or speculative corners. Some day the Labour party will wake up to realize that a cheap breakfast table is better than a free one, and that as regards sugar this condition is more likely to be attained by broadening the basis of supply, through suitable Imperial Preference as now in operation, than by admitting sugar duty-free irrespective of the source from which it emanates. But will they realize it before they do irreparable damage to the Imperial sources of supply which are our mainstay against a new era of sugar cartels? We can only hope so.

Beet Sugar or Cheap Sugar at Home.

The uncertainty of the Government's intentions with regard to the infant beet sugar industry at home prompted Lord Denbigh last month to write to the *Times* urging that no total abolition of the excise duty should be countenanced. This drew replies, first from the Secretary of the Manufacturing Confectioners Alliance (as representing the sugar users) and afterwards from Sir Leonard Lyle (as spokesman for the refiners). A sort of triangular duel resulted. Mr. Leonard for the Alliance is out for cheap sugar as the sugar users have always been, and he repeated the now well known arguments in favour of cheap confectionery for the masses. He belittled the home beet sugar industry, forgetting that its present dimensions are no criterion of what it could be in time under a consistent policy of support, while he put in a plea for the home fruit trade which needs cheap preserving sugar. The last plea brought the pertinent reminder from Lord Denbigh that in this country a single night's frost at the wrong season may easily spoil the fruit harvest, while sugar production has a more certain tenure and fifty factories might in time be possible. He enquired why the refiners did not go into the home beet industry on their own part instead of encouraging foreign sugar. This brought in Sir Leonard Lyle with the explanation that the refiners objected to a sugar duty which favoured direct consumption sugar at the expense of British refined made from foreign raws. In effect what they want is that all British sugar whether home or colonial should be manufactured to a raw finish so that the refineries at home can have their finger in the pie—or should we not say, the sugar bowl—and complete the manufacture to their own profit. But we are not told why the refiners cannot see their way to running a raw beet factory or two of their own at home and send the raw beet to their refinery for completion of the process. Nor do we see why they should not emulate the example of their American rivals in Cuba, and run raw cane sugar factories in some of our colonies to ensure a supply of their raw material.

That is one aspect of the matter. Another is that in asking that sugar manufacturers at home and abroad should confine themselves to producing raw sugar.

and not the direct consumption brand, they are in effect asking that the march of scientific development should be stayed for their particular benefit. On the contrary, if sugar manufacturers can solve the problem of turning out a sufficiently refined article in one operation, it is better and cheaper than two separate treatments by two different parties, and it stands to reason that they will prefer to retain the extra profit themselves. For these reasons the development of the manufacture of direct consumption cane sugar is bound to receive sustained attention from sugar experts and chemists till a sufficient measure of success crowns their efforts. As regards beet sugar, success has already been achieved, since in the modern beet factory it is possible without any difficulty to produce a very excellent grade of granulated, which rivals that turned out by the refiners.

Cost of Sugar Production in Louisiana.

Labour in the southern part of the United States is becoming scarce and consequently dear, whether in the great cotton belt or in the Louisiana sugar plantations; and, according to the Year-book of the United States Agricultural Department for 1923,[1] the matter is rapidly becoming critical as regards sugar production. It appears that this state of affairs is mainly due to a migration northwards of the negro to factories where he can command better wages than in the agricultural tracts in the south, and this migration is said to have been growing at an increasing rate during several years past. In a table compiled from data collected over some 4000 acres of cane, of which about one-half was plant cane (fall planted and spring planted in equal quantities) and one-half ratoons, the cost of cane, from seed to harvest during the 1922 crop, came to just over $5 per ton. It is pointed out that Louisiana has to compete with countries where labour is almost "unbelievably abundant and cheap," as compared with the local scale of about $1·25 per man-day. But it is our opinion that, if such a competition existed in full force, i.e., without any form of protection, the Louisiana sugar industry would soon cease to exist.

Taking any set of countries in the tropics producing one and the same product, whether it be sugar, coffee, cotton or what not, the cost of labour in man-days differs so enormously that it is difficult to understand why the production of each staple does not tend more to concentrate into the hands of the most favoured communities. But when we study the matter more closely, we find that there are numerous other factors which have to be considered, such as the variety of the staple grown, the character of its produce, suitability of climate, efficiency of labour, freight charges, capital available, fiscal arrangements, etc. Thus, taking what are perhaps the extremes of the cost of labour per man-day, how is it that India, with perhaps the cheapest, and Queensland with the dearest, are equally dependent on protection in order to produce, and, more so, to export sugar? In India the climate is unsuitable for the growth of tropical canes and there is a lack of capital; neither of these adverse factors is present in Queensland, but the crushing expense of white labour in the fields makes it impossible to follow the usual practice of large plantations, and these are split up into numerous small privately owned farms whose produce is worked up in large, up-to-date central factories. In Louisiana the climate is unsuited to the growth of tropical canes requiring a full year or more to mature, the growing season is very short, and the tonnage of canes produced is not much more than it is in India, 17 tons from plant canes and 12 from ratoons being given as the average for the 1922 crop. And this, added to the comparatively high rate of wages which are at present demanded, leads to the suggestion that perhaps the ultimate solution of the difficulties in the industry lie in the direction taken in Queensland, of similarly splitting up the plantations, with presumably the advantage of a certain amount of negro labour.

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[1] *Facts about Sugar*, 1924, 18, No. 7, 153.

In this connexion we may refer to an interesting table given in the Report of the Indian Sugar Committee (1920), giving the relative pre-war cost of making sugar in certain countries. These fortunately include Louisiana, and the others are Porto Rico, Cuba, Hawaii, Java, and two separate tracts in North India, where white sugar is made. The costs are calculated per standard maund (82·28 lbs.) in annas (practically pence). Louisiana heads the list with a cost in canes of 124·1, and manufacturing costs 39·8, making together 163·9 pence per maund of sugar produced. The figures for the other countries in order of total cost are: United Provinces 93·1 + 48·0 = 141·1, Porto Rico 85·5 + 24·9 = 110·4, Bihar 58·85 + 48·0 = 106·85, Hawaii 77·4 + 14·0 = 91·4, Java 34·5 + 34·5 = 69, Cuba 42·4 + 18·5 = 60·9. These differences in the cost of growing the canes and making sugar from them are sufficiently remarkable, and the study of the local conditions which have led to them, and yet have made it possible for these countries to enter into competition should be a very interesting one. It is easy to see, for instance, how Cuba and Java have obtained their dominant position, while Louisiana and India cannot compete in the open market.

Researches on Sereh in Java.

Apropos of the increasing difficulty experienced in diagnosing some of the best known and most widely spread diseases of the sugar cane, we would draw attention to the laborious investigations which have recently been undertaken by the Microbiologist of the Pasoeroean Experiment Station in Java as to the cause of the sereh disease. Perhaps none of the many sugar cane diseases has, during the past thirty to forty years, received so much attention as sereh, with apparently so little result. The whole strength of the Java Experiment Station staffs has been at intervals concentrated on it, and for the quarter of a century after the first scientific paper was published in 1885, almost every year saw one or two papers devoted to its description and elucidation and the means of controlling it. But during the past dozen years there has been a lull, as if repeated failure to get a general acceptance of any of the varied theories put forward had acted as a deterrent from entering this difficult field. Any reported discovery of the cause of sereh was bound to be received with the utmost scepticism, and the patient and prolific Dutch workers appear to have given it a wide berth and devoted themselves to more productive spheres of labour.

But it is a long time since the first commencement of the bacteriological line of attack ended in failure, and vast strides have been made since the nineties, when the last paper was published, not only as to the general view of the rôle of bacteria in plant diseases but also in the technique of the study of micro-organisms. And WOLZOGEN KÜHR appears to have welcomed the demand made upon him in 1917 to reopen the subject and thoroughly to investigate the micro-flora of the interior of the cane, both in healthy plants or in those attacked by sereh. Some details have been extracted from the paper which he published last year giving the results of his investigation, both in the present and a recent number of this *Journal*, such as may be of interest to readers. He found that almost all of the canes which he examined, whether healthy or diseased, showed the presence of bacteria inside them, chiefly it is presumed in the wood vessels which appear to be the focus of the sereh attack; and, further, he was able to isolate a definite form which invariably accompanied the external symptoms of the disease. Upon submitting this form, however, to the extremely rigorous modern tests, he failed to reproduce any but the earlier symptoms of the disease, and these he was also able to induce by other methods. He therefore remarks that "the question of the cause of sereh has received no new light." We are inclined to doubt, however, after reading the summary of his results at the end of the paper, whether this statement is not of somewhat too sweeping a nature, and whether his modest disclaimer will be altogether approved by the pathologists of the day, to whom the decision must be left. To us it would rather seem that he has made some distinct advance along the path by which the problem of the cause of this mysterious disease will ultimately be solved, if it ever is.

And one point of view, with which we are in hearty accord, has received a considerable amount of emphasis, namely, the necessity of increased attention being paid to all the cultural operations in the fields, as a main plank in the campaign against most if not all of these diseases of the cane fields. **Wolzogen Kühr** claims to have shown the great difference existing in the resisting power of canes to sereh, according to the care exercised in giving them the best chances of growing into healthy plants. In fact, he reports that he has been able to raise perfectly healthy stools from sets obtained from heavily infested plants, by simply growing them under optimum cultivation conditions; and it is significant that, in such healthy plants, raised from those surcharged with the particular form of bacterium always met with in the vessels of diseased specimens, the bacteria had entirely disappeared.

Sugar Production in Brazil.

Brazil now ranks fourth among the countries producing cane sugar, that is to say it follows immediately after Cuba, British India and Java, its output for 1923-24 being estimated by its Ministry of Agriculture as 644,200 metric tons. A recent commercial report[1] gives some particulars regarding conditions in that country which are worth summarizing here. It is pointed out that the sugar industry there is remarkable chiefly for its particularly wide geographical distribution. It is produced in every State, although in relatively small quantities in a few, such as Amazonas and Parana. Pernambuco, Minas Geraes, and Rio de Janeiro are the largest producers, together accounting for over half the output of the entire country; while the northern State of Alagoas is a heavy producer, as is also Sao Paulo. The possibilities of expansion of the industry are great, owing to the favourable conditions of climate and soil, and to the large areas of land suitable for the growing of cane.

As a whole, however, the position of the Brazilian sugar industry is not financially strong. In fact, mill operators who are not heavily compromised by obligations assumed between 1917 and 1920 are an exception. Generally these debts represent purchases of equipment made at a time when the immediate prospects of the business were excellent and exchanges also favourable; but the resumption of more normal competitive conditions in the world's markets and the sensational fall of milreis exchange since 1920 increased the burden of these obligations to a point at which the solvency of otherwise sound concerns was seriously threatened. However, the good returns of the 1922-23 crop have enabled the industry to make a substantial advance toward recovery; and another year of equal profits should re-establish the sugar interests on a still more solid footing. The large produce brokerage houses in Pernambuco, Rio de Janeiro, and Sao Paulo have tended to gain control of sugar *uzinas* in their territories, by the system of advances and loans on crops to which the industry has been accustomed. Encouraged by the example of the valorization of coffee, the sugar interests have made persistent efforts to obtain Government aid for their business. After long agitation the project for the establishment of a *caixa de assucar*, or sugar fund, became a law on January 7th, 1922. This law authorized the Federal Government to purchase sugar for the purpose of maintaining the price, but the provisions contained in it have never been put into execution because of the objections it raised.

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[1] *American Commerce Reports*, January 7th, 1924.

Though remarkable progress has been made in some localities, much remains to be done before the sugar industry of Brazil is equipped on the same scale as is that of Cuba or Hawaii. The majority of mills now operating are in need of more modern machinery that will enable them to utilize to greater advantage and with greater economy the cane which they grind, and, moreover, to increase their operations. But the development of the sugar industry (as of any industry in Brazil) is strictly limited by transportation facilities. Present conditions are such that there can be no great industrial expansion except in areas so near the coast as to be altogether or nearly independent of railway transportation. Both the Campos and Pernambuco zones suffer from the lack of rolling stock to carry their crops, and other localities are hindered only to a lesser degree.

Cantley and Kelham's 1923-24 Campaign.

Commenting on the necessity of extending the beet sugar industry in this country, Mr. ALFRED WOOD, Secretary of the British Sugar Beet Growers Society, Ltd., writes that the average sale price of home-grown sugar produced during the past season has been certified by Messrs. Price, Waterhouse & Co., the auditors to the English Beet Sugar Corporation, Ltd., and verified by Sir WILLIAM PLENDER, Bt., G.B.E., on behalf of the growers. The figure is 55s. 3d. per cwt., showing that a high quality of white sugar has been made. The growers had already been paid for their beet on the basis of 40s. per ton delivered at the factory with 15½ per cent. sugar content, and as beets with a higher sugar content have been grown, a further price (up to 8s. 9d. per ton for roots of 19 per cent.) has been paid. Cheques for £80,000 have now been distributed among 2000 growers for the Cantley and Kelham factories, their crops averaging eight acres per grower.

In the depressed condition of agriculture this money will be specially welcome to all the farmers concerned. It could only have been earned by the production of good sugar on the part of the manufacturer from good beets supplied by the grower. The extent to which the agricultural advantages of the crop are now appreciated by the farmer is proved by the fact that the Cantley factory in Norfolk has already contracted for over 11,000 acres for the present growing season, but only a small additional acreage can be accepted in view of the capacity of the factory. Of this area, over 75 per cent. is under a three years' contract commencing this season, in accordance with the recent arrangement made with the National Farmers' Union.[1] It is not expected that in the immediate future the market price of sugar will fall to a material extent, and it is even more doubtful that if there is a reduction of the duty the consumer will secure the expected relief. The fact is that world production has still a long way to travel to meet the normal world demand, which is increasing, and the obvious remedy is to produce more sugar at home.

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[1] See *I.S.J.*, 1924, 66.

Fifty Years Ago.

From the "Sugar Cane," March, 1874.

An anonymous article on "Animal Charcoal in Sugar Manufacture" was published in this number of our predecessor, and it appears of a little interest to make a few extracts from it to show the ideas prevailing at that time regarding this important material. "Opinions differ as to the explanation of the action of charcoal on solutions with which it comes into contact. It is generally believed to be the effect of surface. All solid bodies possess the power of condensing, so to speak, on their superficies, solid matter dissolved in liquids, and this faculty becomes much more decided when the surface is very extensive. Animal charcoal, with its microscopic cells, possesses an enormous surface, and thus can exercise the action in question to a very high degree. However, surface alone does not determine the purifying action. Substances other than animal charcoal with a surface correspondingly great produce a far less effect, so thus the nature of the filtering medium has a very great deal to do with the results obtained . . . . . The absorbing action of animal charcoal is not the result of the property due to surfaces in general, but is a special effect peculiar to porous carbon, such as results from the calcining of the cellular tissue of bone." An outline of the manufacture and the revivification of char followed in these days was given. In regard to the selection of raw material, it was mentioned that "It is only hard and compact bones which furnish charcoal of the best quality; while spongy or cartilaginous bones give a shining product of poor qualities." As to revivification at that time, it was general to effect this by inducing a fermentation process by placing the material in a slightly damped heap, the absorbed organic and nitrogenous impurities thus being decomposed. Subsequently the char was washed with dilute hydrochloric acid, and re-burnt.

A second paper to which attention may be drawn, was a description of Lagrange's process of purifying juices and syrups, of which great things were predicted at the time of its proposal. Ammonium phosphate was added at a suitably high temperature, this having the effect of precipitating the calcium salts in solution (while ammonia was evolved), after which baryta was stirred in, its action being to throw down sulphates and also (it was stated) organic matter. On heating the mixture to boiling point, "there is effected at one and the same time a true chemical purification and a clarification equal to that obtained by the albumen of blood," the last stage of the process being to send the liquors through Taylor filters. The usual claims made for such processes was made in this case, namely that "the working of the cuites, the crystallization, and the turbinage, are accomplished with the greatest regularity and under the best conditions"; while further there was obtained "an augmentation of yield."

S. Dana Hayes, State Assayer for Massachusetts, gave an analysis of a certain scale which he had found adhering to the coils of the vacuum pans in a refinery, this deposit being troublesome only when working *melado* sugar. According to the analyses given, the scale was almost pure silica, comparatively small amounts of lime and magnesia being the only other ingredients reported. In appearance it was "laminated, almost crystalline, opaque"; and it appeared to be remarkable that "the silica should pass through all the previous processes of the refinery, even treatment with char, and finally become deposited as described."

Researches on the Sereh Disease in Java.

II.—Its Relation to Bacteria.[1]

Although the science of bacteriology is emblematic of the great strides made in pathology during the past quarter of a century, these organisms are certainly no new thing in this world. We now know, for instance, that they existed in quantity in paleozoic times, in that their presence has been demonstrated in microsocopic sections of plant tissues laid down during the coal period. But, naturally, until the discovery of the magnifying power of glass lenses, such minute organisms entirely escaped our observation, and we were altogether unaware of the presence and character of micro-organisms. This enlarging power of curved glass surfaces must have been observed in very ancient times, for it is claimed that the making of glass vessels had already attained as great perfection among the ancient Egyptians, Phœnicians and Greeks as they have at this day; and everyone passing a glass bowl filled with water is constantly struck by the enlargement and distortion of objects looked at through it. No knowledge of bacteria is recorded until the end of the 17th century, when the discovery or possibly rediscovery of the microscope opened up the micro-world to many enthusiastic students of nature. Every conceivable object was examined through the primitive magnifying lenses, and it is a remarkable fact that such minute organisms as bacteria should have been detected with the imperfect appliances of the day. The credit of this discovery belongs to a Dutchman named Leeuwenhoek who, in 1680, not only observed them but demonstrated their wide distribution; and, what seems more remarkable still, noted their close connexion with putrefaction, as well as their specially rapid multiplication in certain human diseases, thus forestalling in a certain sense the work of modern bacteriologists. But the imperfection of the instruments of the time made it impossible, of course, to proceed much further; and it was not until the modern compound microscope had been evolved and elaborated, and the numerous aniline dyes were produced to serve as staining and separating reagents, that the foundations of the science could be securely laid down. And this brings us down to our own times.

The modern science of pathology, connected with micro-organisms, is unanimously traced to the work of Pasteur, who successfully fought down the general opposition to his opinions by a series of brilliant researches towards the close of the last century. But his work related mainly to the diseases of animals, the character of whose tissues and mode of life everywhere made access easy for the invisible germs. The matter was not so easily settled with regard to plant diseases; it being at first held, as a useful point of view that, while animal diseases are often caused by bacteria but rarely by the invasion of fungi, the converse holds with plant diseases, these being often traceable to fungi but rarely, if ever to bacteria. The main foundation for this point of view is quite sound; for by means of their cell walls plants have so to speak armed themselves against these intrusions. Each plant is covered over by a complete and impermeable mantle of cutin, a substance which, while not able to prevent the entry of many kinds of fungi, is proof against bacteria; and the passage of the latter from cell to cell is further hampered, if not prevented, by the network of firm walls separating the individual cells from one another. We know that the surface of every plant is covered with colonies of the most varied bacteria, but it suffers comparatively little inconvenience therefrom. A great fight has thus raged ever since Pasteur's time as to the possibility of bacteria causing plant diseases.

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[1] The first paper on the subject appeared in our January number, pp. 18—23.

The study of plants supposed to be attacked by micro-organisms is thus beset with its own difficulties, some of which are as follows. Where bacteria or fungi are found in the internal tissues of diseased plants, it is often not easy to determine whether they are causative agents of the trouble, or have profited by the breaking down and death of cells by other means. Bacteria are not usually met with in living plant cells, but are always ready to infect wounds, however slight these may be, and some of these wounds, for instance those caused by the insertion of the setae of sucking insects, leave little trace of their presence afterwards, thus causing the "accidental" presence of bacteria in perfectly healthy tissues. There are, on the other hand, well known cases where bacteria and fungi live symbiotically within certain host plants, and confer undoubted benefits on these by their presence. We have, lastly, to accept the awkward fact that, in perfectly normal and healthy higher plants, there are considerable sections of dead tissues, which perform important physiological functions for the plant and in which micro-organisms may congregate. These aspects, among others, are carefully developed by Wolzogen Kühr[1] in his studies of the micro-flora existing inside sugar canes suffering from sereh, as compared with that found in healthy plants in Java.

(1) Owing to the frequent presence of bacteria in moribund or decomposing living matter, it is peculiarly difficult to determine whether they are parasitic of saprophytic forms, that is whether they are the actual cause of the death of the cells or are feeding on cells which have been otherwise injured or crippled. It has been therefore necessary to submit these associations of micro-organisms with plant tissues to extremely rigorous tests. The author agrees with the following criteria laid down by E. F. Smith,[2] who for a number of years has devoted himself to this branch of plant pathology. Such a micro-organism must be constantly present in the diseased plant; it must be capable of isolation and growing in separate culture media; when healthy plants are inoculated from such cultures the diseased condition must follow; the organism must be again isolated from such artificially diseased plants; and finally it must be raised again from such diseased plants on media, so as to prove on examination that it is the same micro-organism as that at the commencement of the series. The author further quotes Smith's verdict upon the previous Java work on sereh. "None of the Dutch writers have brought any conclusive evidence as to the parasitic nature of sereh, i.e., they have not established the constant presence of any particular organism in the diseased cane; neither have they shown that the disease can be induced by inoculating any particular organism. At the same time, no thorough bacteriological study appears to have been made." As will appear in the sequel, Wolzogen Kühr has accepted this standpoint and carried out the necessary tests in his laborious investigations of the micro-flora of diseased and healthy cane plants, and recommends that such a course should invariably be adopted by future workers in this field.

(2) The first point taken up by the author is an examination of the dictum that the cells of living healthy tissues are as a rule free from micro-organisms; and he summarizes the complicated series of investigations undertaken in this field, since Pasteur, as the result of his experiments, asserted that this was the case. Pasteur further showed that sap obtained from the tissues of healthy plants remained sterile as long as it was properly protected from external infection. In this he was supported by Chamberland, who demonstrated it with beans taken from the pods at harvest, and other writers. Galippe (1887), working with vege-

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[1] *Archief voor de Suikerindustrie in Nederlandsch-Indië*, Jaargang, 1923, No. 9

[2] Erwin F. Smith, Bacteria in Relation to Plant Disease, Parts I-III, 1905-14.

tables obtained from the market, found that, with hardly an exception, those examined by him had bacteria inside them; but, on his work being repeated with more rigid precautions against casual injury so as to be fresh and sound, it was found by a number of workers that this was not the case. Similarly, BERNHEIM (1888) found bacteria in various plant seeds; but again, on the repetition of his work by various other writers, his conclusions were negatived. Summing up the results of all this work, the author again quotes SMITH as writing in 1911. "We now believe that bacteria do not occur normally in the interior of sound plants."

This leads the author to the idea that the presence there of such bodies indicates a diseased condition, unless the invaders soon die. But he finds that this idea needs qualification, in that RUSSELL, in demonstrating that sound seeds are free from bacteria (1892), found that bacteria, if carefully inoculated into healthy plant tissues, may continue to live for quite a long time (over 70 days), without perceptible influence and even with a limited amount of migration from cell to cell. At the same time he proved that wounds inflicted experimentally might heal up, so that later on no trace of them was perceptible. He therefore made the suggestion that this fact may have contributed to the discordant results obtained, e.g., those of GALIPPE and BERNHEIM. In other words, the *accidental* presence of bacteria may occur in quite healthy plants.

(3) The author then reviews briefly the subject of symbiosis between micro-organisms, that is fungi and bacteria, and certain of the higher plants. He first refers to those cases where the higher plants are assisted by micro-organisms in obtaining their nitrogenous food, and mentions specifically *Bacterium radicicola* in Leguminosæ, Anabæna in Azolla, and *Mycobacterium rubiacearum* in various species of that order. Cases where the advantages are less obvious then follow: *Bacterium foliicola* in Ardisia (Myrsinaceæ), and a fungus in *Lolium tementulum*, where there can be no question of nitrogen fixation. A different series is afforded by the fungi inhabiting the roots of many higher plants, usually included under the general term Mycorrhiza; here he distinguishes between those on the outside of the roots (ectotrophic) and those living in the interior tissues (endotrophic), of which the latter alone are of interest in this discussion. Lastly, he draws attention to the remarkable case of certain Orchidaceæ, where the presence of a fungus appears to be necessary for normal development, as even the seed cannot germinate unless the embryo is first invaded by the appropriate hyphæ. The way in which the cells of this embryo not only tolerate but, so to speak, welcome the entrance of hyphæ, usually so destructive to vegetable tissues, causes him to indulge in certain speculations regarding the relations existing between micro-organisms and the tissues of the higher plants.

(*a*) Micro-organisms may increase at the expense of living cells. In certain cases the cells die and those next to them are then invaded, with a resulting death of tissues or even whole parts of the plant, and thus producing pathological conditions. When acting in this way the foreign bodies are termed parasitic, and such cases are now known to be far from uncommon in nature. (*b*) In other cases it is clear that the cells, although not proof against penetration, may attack and apparently completely destroy invading bacteria. (*c*) Between these two a third possibility exists. The micro-organisms may develop well in one portion of the tissues without causing any damage, whereas their passage to another portion is resisted, and at the line separating these two portions the bacteria may be immediately destroyed. Thus a compromise is arrived at between the plant and the micro-organism with resulting symbiosis, and to quote BERNARD: "La symbiosis est à la frontière de la maladie." All stages may occur between parasitism and symbiosis on the one hand, and symbiosis and full immunity on the other.

(4) The next point dealt with by the author is the presence of micro-organisms in the dead tissues inside the higher plants. These dead tissues sometimes perform important functions in the physiology of the plant, e.g., the wood vessels, and it is not necessary or indeed usual for the micro-organisms to obtain entry through the surrounding living tissues, which are generally entirely free from them. Once inside, they may proceed for considerable distances with the flow of nutrient material; and not of necessity only in the direction of the ascending water, for, according to the results of recent research, it appears highly probable that the vessels, at any rate at certain times, are capable of passing large quantities of formed food material in the opposite direction. If food is present the micro-organisms may increase to such an extent that, with the formation of carbohydrate matter, they may completely block up the cavities of the vessels. In this case the physiology of the plant is seriously disturbed, and even death may occur; and although occurring only in dead tissues, we are accustomed to describe the invading organisms as parasitic.

As throwing light upon the manner in which such organisms obtain access to the vessels, the author refers to GÄUMANN'S researches on a fibrovascular disease of bananas in Java. After an exhaustive examination of all the varieties and species in Java, he found that, while the wild forms were universally free from the presence of micro-organisms in the vessels, they existed in practically all of the cultivated plants examined, whether perfectly healthy or showing signs of disease. He naturally refused to consider all of the Javan bananas as diseased. The bacteria were traced to the root stock, which of course is in direct communication with every part of the plant, and he preferred to speak of "relative" healthiness, this often depending on whether the bacteria were mostly confined to the underground parts or were widely distributed. It is an easy step from the banana to the sugar cane, whose root stock contains many decaying portions; while the planted set, from the first, may serve as a wound spot from which a constant stream of rot bacteria may be transmitted through the vessels to the parts above ground, without necessarily causing any specific disease phenomena.

It is impossible in a short space to follow the details of WOLZOGEN KÜHR'S study of the microflora found in Java sugar canes, and we have to be content with referring to the summary of his results appended at the end of his long paper (164 pages), the main features of which are as follows:—

(1) A new method has been evolved for obtaining cell sap from the interior of the sugar cane stem, which excludes the possibility of infection from without.

(2) This method is adapted to the study of the presence of micro-organisms in sound and sereh-attacked canes. . . . .

(4) The examination of 591 thoroughly healthy stems from different localities in Java showed that, in nearly all cases, saprophytic forms of bacteria appear to be present; only in half a dozen samples of different varieties collected at about 3000 ft. elevation were these absent.

(5) A similar study of sereh-infected stems showed the constant presence of a definite kind of bacterium.

(6) An extended study of this form showed it to be identical with or very nearly related to one named by BURRILL and DUGELLI as *Bacterium herbicola aureum*.

(7) In shoots of cane plants raised from sereh sets, it was demonstrated that this bacterium appeared at the same time as the colouring matter of the bundles.

(8) Introduction of this bacterium into the stems of perfectly healthy canes brought about the beginning of sereh appearances, namely the red coloration of the bundles. But injection of the bacteria into young shoots and sets by various methods failed to call forth further sereh appearances.

(9) Later experiments showed that cultures of other bacteria also produced the red colouring of the bundles.

(10) It was also induced by a series of chemical compounds; this showed that the red colouring was a necro-biotic phenomenon in the dying elements of the stem tissues, followed by absorption into the cell walls. The presence of an acid appears to be necessary for its appearance.

(11) A preliminary examination of the red colouring matter makes it probable that it is identical with or closely related to purpurine. . . .

(12) In agreement with the findings of former workers, it has been demonstrated how great an influence is exerted by the relative resistance of the cane to an attack of sereh, according to more or less favourable conditions of cultivation. As the result of experiments it was proved that in many cases it was possible to raise quite healthy plants, under optimum conditions, from severely attacked sereh sets. Such recovery was accompanied by the disappearance of the constant concomitant of sereh, the *Bacterium herbicola*.

In describing his work in the introduction to the paper, WOLZOGEN KÜHR writes as follows.—" It will be seen that a specific micro-flora has been found in sereh plants, and that inoculation did not succeed in reproducing the disease; therefore the cause of sereh has received no new light. The value of the work is that it is the first research under the new conditions with the micro-flora of healthy and sereh-infected plants, and this method should be followed by all workers on parasitic diseases in the sugar cane in future."

C. A. B.

New Companies recently registered in the United Kingdom, include: Garton, Sons & Co., Ltd.; Capital £500,000; sugar refiners, etc. Anglo-Scottish Beet Sugar Corporation, Ltd; Capital £250,000; manufacturers and refiners of sugar. Scottish Molasses and Patent Foods Co., Ltd.; Capital, £1000.

In its report for the year ending March 31st last, the Victoria Nyanza Sugar Co., Ltd., states that after two years of preparation crushing was begun on December 9th, 1922, and continued until February 9th, 1923. Delay in commencing operations was due to the engineers' strike in this country holding up delivery of plant, and to unfavourable weather. Operations were conducted with the handicap of an insufficient water supply, but the Company in spite of the adverse conditions is able to declare a nett profit of £1699 for the year under consideration, and the directors are confident that it will be on a dividend paying basis in the near future. Over 30 tons of cane per acre were obtained from the first 100 acres of cane cut.

In a consular report on economic conditions in Mexico,[1] it is stated that the sugar industry has suffered heavily owing to the revolution, which has ruined it in Morelos, one of the principal sources of supply. The amount produced in Vera Cruz was somewhat in excess of that produced in the previous year, but there is no doubt that under normal conditions, with a return to times of security and the introduction of modern machinery and methods, this industry is capable of great expansion. Government reports state that 98 per cent. of the sugar mills in Mexico have defective grinding machinery, and that only 10 per cent. of the suitable land is being cultivated. In the 11 States where the cane crop is chiefly grown, there were 600 mills working in 1922. The crop is given by the Government as having been 120,730 tons.

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[1] "Report on the Economic and Financial Conditions in Mexico." By NORMAN KING, H. M. Consul-General, Mexico. (H. M. Stationery Office, London), 1924. Price: 1s. nett. Issued by the Department of Overseas Trade.

Report on the Petree Process at Puunene and Paia, T.H.[1]

By S. S. PECK.[2]

EFFECT ON MILL ROLLERS.

At Puunene there was no question that the return of the hot mud affected the roller surfaces very adversely. It appears that the polishing action was not so much due to the mud itself as to the absence of the natural acidity of the juices in the blankets, whereby the roller surface was not continually roughened by etching action. This was evidenced by the fact that the rollers lost practically no metal during the season. But, particularly in the case of the top roll of the fourth mill, where it might be expected that this action would be least effective, it was necessary to re-groove very frequently. All the top rolls are grooved 8 to the inch. As a consequence of the polishing, there were frequent chokes at the mills with corresponding delays. The condition was partly corrected by: (1) Using cold maceration water, when it was seen that the colder the bagasse blanket, the better it seemed to feed. (2) Cooling the settlings returned to the mill. In both these cases we explain the improvement by the lesser swelling of the fibre particles due to the lower temperature. (3) Fine straining of the juice before clarification. The evidence was particularly noticeable at the first mills, where that side of the rolls to which the returned "cush-cush" was directed lost its polish after a few days. It is also explained by the probability that in removing the fine absorbing cane particles, less material of alkaline nature was being returned to the mill, the acid reaction of the natural cane juice to a large extent being restored.

At Paia there was much less slippage at the mill, although it occurred to some extent. It is probable that this was due either to the Meinecke chutes, which allowed a slower and better penetration of the mud into the bagasse blanket, or to the coarser grooving of the top rolls, which was 4 to the inch. There was no strainer at Paia and hot mud was returned, but it was found advisable at times to use cold maceration water.

EFFECT ON EXTRACTION.

The next usual question concerns the extraction and for the purpose of comparison, the figures for 1922 and 1923 are given:—

	PUUNENE.		PAIA.	
	1922.	1923.	1922.	1923.
Cane, polarization	14·78	14·25	13·54	13·45
Cane, fibre	12·53	11·95	11·83	11·76
Dilution per cent. normal juice	36·09	38·11	25·57	47·95
Extraction	98·19	97·02	96·99	97·56
Extraction ratio	0·14	0·25	0·26	0·21

It is to be noted that the difference between the two years should be a little greater, because of error in the calculation of the bagasse weights due to the returned solubles in the mud.

We feel certain that the extraction at Puunene was low on account of the large volume of juice returned to process with the mud, thus preventing the proper circulation of return maceration in the usual manner. This amounted to about 30 per cent. of the cane. A calculation with assumed figures for fibre in bagasse and factors for admixture of maceration water substantiates this. During the

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[1] Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1923.

[2] Sub-Chairman, Committee on Petree Process

1924 season, with a better acquaintance of the conditions attending the process, it is expected that a return to 98 or better will be obtained.

At Paia better results for 1923 than obtained in 1922 as regards extraction were shown, but the dilution figures explain this. The 1923 extraction figures would have been still better had it not been for some trouble at the last mills in the driving gears which could not be corrected until between seasons.

Question of Fuel Economy.

There was a decided saving at Puunene, so much so that at times up to 600 kilowatts were furnished for outside power from the mill power plant, and no oil was burned after the month of February. But there were other conditions aside from the Petree process which contributed to this economy. Some changes made in the boiler installation were largely responsible, and molasses were burned under the low-pressure boilers. It is, therefore, difficult to estimate how much of the reduction in the fuel bill is due to the process, but it is certain that from the less loss in radiation, the elimination of the filter-press station, and the extra fuel from the returned mud, this was no small figure.

At Paia, however, the irregular grinding and the poor work at the last mill, leaving a high moisture in bagasse alone, explain the demand for extra fuel which was greater than in 1922, but less than in 1921. The difference in results in the two factories makes any positive statement in this connexion quite impossible.

Recovery Comparisons.

In both factories a higher recovery was reported than in previous years. In attempting this comparison, it must be remembered that there is no mixed juice figure on which to work. We have made a calculation for Puunene, starting with the crusher juice, which is a fairly reliable figure in this factory, and calculated a theoretical recovery from these purities, 100 extraction, the purity of the sugar as produced, and a 36° gravity purity molasses. This figure compared with the actual recovery takes into account any improvement due to clarification.

Recovery, per cent. Polarization in Cane.	1921.	1922.	1923.
Theoretical	93·93	93·90	94·42
Actual	89·61	88·57	90·77
Efficiency	95·40	94·32	96·13

It should be noted that in 1921 the cane was ground in a 15-roller mill. The figures reflect approximately the savings due to no filter-press losses, to less undetermined losses, to a better rise in purity during clarification (measured by the less drop in purity from crusher juice to syrup) and include also the greater loss in extraction in 1923. While not above criticism, we believe these demonstrate a real gain in sugar in the bags over the previous years.

Quality of Products.

The clarification of the juices, the resulting syrups, the commercial sugar, and the low grade work were all favourably affected. The juices and syrups were brilliant; the sugars cleaner even than with the juice filtration previously practised; and the low-grades worked so much better that only 60 per cent. of the low grade centrifugals were required throughout the crop.

Labour Economies.

There was no saving in labour costs in the milling department. But in the boiling-house there were fewer men used, because of the elimination of the filter-press station, and the running of a less number of low-grade centrifugals.

Report on the Petree Process at Puunene and Paia. T.H.

As part of this report, we include a letter from Mr. E. E. HARTMANN, an old-time resident of Hawaii, and now with Petree & Dorr, Engineers, Inc. His calculations are based on figures supplied him from the factory records.

By E. E. HARTMANN.

Having arrived in Honolulu after the two Petree process plants had shut down, I can, of course, only comment on the results.

The outstanding feature of these results is the 3 per cent. increase in boiling-house recovery (2·93 per cent. sucrose in cane as compared with 1921, and 3·11 per cent. as compared with 1922, based on the theoretical recovery of 1923). There was a loss in mill extraction, amounting to 1·45 per cent. sucrose in cane as compared with 1922; but 1921 cannot well be compared with the last two years, as five mills were used in that year. The net gain was 1·67 per cent. sucrose in cane, or more than 800 tons of sugar. We have every reason to look forward to a much better total recovery next year, as steps are now being taken to remedy the conditions, which led to the falling off in extraction.

A good deal of mud was circulated (Mr. PECK found the settlings to amount to as much as 30 per cent. of the cane), and it looks to me as if the Ramsay macerator was not a suitable distributor for the mud. The impression I have received from descriptions of this apparatus, is that where the macerating mud strikes the surface of the rather compact blanket of bagasse the clear liquid is absorbed, the mud forming a cake on the surface, clogging it against access of more macerating mud. As a result, a portion of this mud seems to have been carried in pockets to the third mill, there to be re-expressed.

The absorption of this mud in the bagasse is clearly a function of the surface of the latter. At Puunene this surface area was very restricted. One way of remedying this condition would be to break the blanket of bagasse, and to apply the macerating mud from the top at the point where the blanket is broken, thus increasing the surface area of the bagasse.

A radical change in procedure, such as is introduced by the Petree process, is sure to cause temporary disturbances in the factory and it also may effect methods of control. This fact has naturally given rise to a number of objections and criticisms, which I shall here discuss and answer as far as they have come to my notice.

In calculating the mill extraction, it is necessary to take cognizance of the fact that the insoluble matter returned to the bagasse carries off as much (or practically as much) sugar as the insoluble matter in the bagasse. In this instance we find the bagasse per cent. cane originally reported as 21·68 per cent. To this we have to add the bagasse equivalent of $1·02 - 0·07 = 0·95$ per cent. insoluble matter in mud, or $0·95 : 0·55 = 1·73$ per cent. cane. The sucrose per cent. bagasse should therefore be multiplied by $21·68 + 1·73 = 23·41$, instead of only 21·68, and the loss in bagasse per cent. cane is then correctly given as 0·457 instead of 0·42.

EFFECT ON SUCROSE VALUE, PER CENT. CANE.

A question, which the introduction of the Petree process has brought up is: "To what extent does this change in procedure affect the sucrose value per cent. cane?" A slight correction should be made for both the Petree and the filter-press methods of working, as shown below.

Where filter-presses are used the figure for bagasse per cent. cane is slightly too high, because the fibre in the bagasse is compared with the total fibre in cane; and not, as it theoretically should be, with only that portion of the fibre which goes into the bagasse.

A similar small correction should be made where the clarified juice is weighed, as in this case the fibre in the bagasse should be augmented by that portion of insoluble matter, which was not originally in the juice.

These two small errors are cumulative in comparisons, as they tend to make the figure for sucrose per cent. cane slightly too high, where the mixed juice is weighed, and slightly too low, where the clarified juice is weighed.

The insoluble portion of the material entering the mill appearing on factory reports as "gross fibre in cane" has only one outlet in the Petree process, and that is in the bagasse. Where filter-presses are used, a portion of this insoluble matter finds its way into the press-cake.

In the Petree process the ratio: insoluble in bagasse to insoluble in cane, gives a value for bagasse per cent. cane, which for complete accuracy would have to be increased by the percentage of solids precipitated from solution in the juice together with the lime contained in the precipitate. The organic matter precipitated from the juice can (ignoring the formation of volatile products) be approximately measured by the increase in purity of the juice during clarification. This increase has been about 1 in 1921, and 1·1 in 1922. This increase is equivalent to the elimination of 0·15 per cent. cane of solids of the specific gravity of sugar.

If the press-cake amounts to 2·5 per cent. of the cane, and contains 8 per cent. of lime, the lime in the precipitate would amount to 0·20 per cent. cane and the total precipitate to 0·35 per cent. cane. If this precipitate carries off as much juice as the bagasse, the bagasse equivalent would be 0·35 : 0·55 = 0·64 per cent. cane.

The bagasse per cent. cane was originally reported as 21·68, the increase due to the addition of this precipitate is therefore 0·64 : 0·2168 = 3·0 per cent. and the sucrose in bagasse per cent. cane is increased by 3 per cent. of 0·42 or 0·013, making the true loss 0·433 instead of 0·42 per cent, and the percentage of sucrose in the cane 14·263 instead of 14·25.

Where filter-presses are operated, the ratio : insoluble in bagasse to insoluble in cane, gives too high a figure for bagasse per cent. cane, as pointed out above. The correction applied to the 1922 figures was arrived at in the following manner, which is small, still they should be applied when making comparisons:

Sucrose in bagasse per cent. cane as reported	0·27
Sucrose in juice per cent. cane as reported	14·51
Insoluble in press-cake cane as reported	1·02
Precipitate from clear juice per cent. cane	0·35
Insoluble originally in juice cane	0·67

0·67 : 0·55 = 1·2 bagasse equivalent per cent. cane. 1·2 × 100 : 21·75 = 5·5. 5·5 per cent. of 0·27 = 0·015. True sucrose in bagasse per cent. cane = 0·27 — 0·015 = 0·255 instead of 0·27. True sucrose in cane = 14·765 instead of 14·78 per cent.

CLARIFIED JUICE AS BASIS OF SUCROSE CALCULATION.

The introduction of the Petree process has given rise to the question: "Does the substitution of the clarified juice for the mixed juice as a basis for the calculation of the sucrose in the cane affect the latter figure; in other words, is it not possible that a loss of sugar occurs in the process of clarification?"

We know that inversion cannot take place in a sufficiently limed juice. Just at what point of alkalinity a juice may be said to be sufficiently limed has so far been purely a matter of opinion. Experiments recently carried out at the

H. S. P. A. Experiment Station indicate that there is no inversion in a comparatively heavily limed juice, while on the other hand, inversion does take place in juices held at a temperature of 212°F. for a number of hours, even if slightly alkaline. The exact danger point has not yet been established, and it is conceivable that this point may be a different one for different varieties of cane.

That no measurable loss was sustained in clarification at Puunene is evidenced by the Java ratio which was 82·15, 82·39, and 82·37 for 1921, 1922, and 1923 respectively. The above leads to the conclusion that the sucrose weights obtained from the mixed and from the clarified juice are strictly comparable where juices are properly limed.

FACTORS RESPONSIBLE FOR IMPROVED RECOVERY.

The question has been put to me: "Granted that a much higher recovery has been coincident with the operation of the Petree process, is this due to the Dorr clarifiers or to the double clarification; or to the elimination of the filter presses; or to the well-known fact that more attention is paid all around when any important change is made?" I have no doubt every one of these factors helps in bringing about the improvement in recovery. Just what share each of these factors contributes to the result, it is not possible to say.

In regard to the first item I would state that while the Dorr clarifier admittedly gives better clarification than any other clarification system, and consequently a better product, the earlier successes of the Petree process were obtained without it.

It is reasonable to expect that double clarification of the more impure fractions of the cane juice will secure a more complete elimination of the impurities, particularly of those, which are in a very finely divided or even colloidal state. The juice which undergoes double clarification consists of the fractions extracted by the second and subsequent mills, the juice contained in the mud of the primary clarifier (which latter should never amount to more than 10 per cent. of the weight of the cane, at Soledad it amounted to from 5 to 8 per cent.), and the clear juice from the secondary clarifier.

That there is an agglomeration of the particles in the second clarifier different from the ordinary mud, can be clearly seen when comparing the mud discharge from the primary and secondary clarifiers. Whereas the former has a thick and slimy appearance, the latter consists of a freely running mixture of juice of low viscosity with a granular mud.

At Soledad this difference was very striking, and yet the percentage of insoluble matter in the heavy primary mud, and that in the fluid secondary mud was approximately the same, varying between 8 and 10 per cent.

That a large portion of these substances, gums, waxes, and possibly starches, which are present in the juices in a condition so nearly akin to solution that the juice containing them may appear quite clear to the eye, are eliminated by this procedure, is evidenced by the better boiling quality of the intermediate products, and by the better quality of the sugar.

Now we come to the filter-presses. That there are losses sustained in their operation, which do not appear in the figure for loss of sucrose in press-cake, will be generally admitted. The item, "undetermined losses," as we all know, covers a multitude of sins. but there does seem to be a tendency for these losses to be highest when the loss of sucrose in press-cake is lowest. Is it not probable that an appreciable amount of deleterious impurities are redissolved from the press-cake while washing?

There are other drawbacks to the operation of filter-presses. In the best regulated filter-press station, defective cloths will be found, and consequently a faucet here and there will discharge muddy juice. Cloths may sometimes not be properly put on, and a press may leak on the side. There are so many chances that some of the very fine mud shall find its way back into the clarified juice, which we know impairs the boiling-house work.

The last factor mentioned, the psychological one, contributes its share unquestionably to better efficiency. It is so intangible however, that whatever benefit it brings may well be credited to the change which introduced it.

I should like to refer to one more suggestion which has been made, and that is that the quality ratio be used for comparing one year with another. The quality ratio is based on a constant for loss in press-cake and undetermined, and on another constant for the difference between the crusher juice and syrup purity.

As it is just in these items that the Petree process shows the greatest improvement over the older methods, the use of the quality ratio as a basis of comparison between the two methods of working, is out of the question.

If the combined action of all the factors above enumerated brings about such a decided improvement in boiling-house recovery and general working conditions in addition to the direct savings in labour and supplies and a product of better quality, are we not justified in judging the process by its results, leaving the analysis of the various phases and the appointment of the credit properly belonging to each, to the time when sufficient data will be available to do so?

The fact remains that the Petree process has saved the owners of the factory three dollars on every ton of sugar, and there is every reason for expecting better results next year. I leave Honolulu feeling confident that the process will have the benefit of the same searching and fair scrutiny next season as it had last year.

Hawaiian Report on Agricultural Machinery and Implements.

Mr. JAMES GIBB, Chairman of the Committee on Agricultural Machinery and Implements, has issued a report to the Hawaiian Sugar Planters' Association, dated September 30th, 1923, of which the following is a summary:—

HISTORY OF STEAM PLOUGH TACKLE AND TRACTORS.

Believing that the publication of a little of the history of agricultural machinery in the Islands would be of interest, the Committee has collected all available data. The oldest of the power-driven agricultural machinery imported into the Islands is the Fowler steam plough tackle, introduced in the year 1881. Since then there have been 154 sold here, approximately two and one-quarter million dollars having been invested in Fowler steam engines and cultivating machinery in the Islands since the date mentioned. According to estimates, about 90 per cent. of the ploughing in the Islands is done by the steam ploughs, and about the same amount of mould-boarding is performed with tractors on plantations thus equipped.

The introduction of the gasoline tractor into the sugar industry has brought about changes for the better in the agricultural methods practised in the Islands. At the end of 1921 there were 361 tractors in the Islands, with about 5 per cent. scrapped. Of the 361 tractors 14 were rear-wheel drive, and 347 of the caterpillar or crawler type. There were 12 rear-wheel drive type rated at 18 h.p.; 115 of the caterpillar type rated at 20 h.p.; 64 caterpillar and 2 rear-wheel drive type rated at between 20 and 40 h.p.; and 164 of the caterpillar type over 40 h.p.[1] Since then 64 tractors of 60 h.p. or over have been delivered; 10 of 30 h.p.; and 10 of 20-25 h.p., besides quite a number of the smaller rated types. At the end of 1921 the total horse-power of the tractors then in commission amounted to 13,000 h.p. or 6500 drawbar h.p., against approximately 24,000 h.p. represented by the total number of Fowler engines. Estimates have stated the replacement of mules by tractors to be about 25 per cent. in the sugar industry.

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[1] Horse-power mentioned is belt rating; drawbar horse-power is about one-half of the belt rating.

The first "Holt" tractor was introduced into the Islands in 1921, while at the present time a total of 114 have been distributed. This total is made up of four 18 h.p.; eleven 25 h.p.; two 30 h.p.; fifty-nine 45 h.p.; thirteen 60 h.p.; nineteen 75 h.p.; and six Western 10-ton (about 60 h.p.) tractors. The U. S. Government has 255 Holts of various ratings in service at its different posts. The original "Best" tractor was introduced in 1914, but the tractor that is now in use was first sold in 1919. The distributors have up to the present time placed about 90 of them in the field. Of the "Yuba" make, 30 have been delivered with 20 still in commission. The "Cleveland" was brought in about 1917, its total sales amounting to about 125 machines, but on account of the low power and the high upkeep, they have been given up by their distributors. The "Fordson" first put in its appearance in 1921. About 100 of them have been sold, with 20 in industrial work in Honolulu. They are rated at 10 h.p. and their upkeep is reported to be very low. The "McCormick-Deering" tractor was introduced during the early part of this year. During the last eight months six of these have been delivered, two of the 10-20 h.p., and four of the 15-30 h.p. type. The accessibility to the working parts, the solid frame, and the removable cylinders from within the engine block, seem to be features which should count very much in its favour when considering a tractor of this rating.

THE "KILLEFER" SUBSOILER.

An agricultural implement which during the last two years has attracted more attention than it did at its introduction about eight years ago, is the "Killefer" subsoiler. The claims made for it are that a greater depth may be obtained in breaking up the soil, and that in cutting into the ground the material forming the subsoil is not brought to the surface, but loosened in such a way as to allow it to weather before working it up into the surface soil. There are about 50 of these subsoilers in use in the Territory; the pineapple industry has quite a number, but the majority are in use in cane cultivation.

PLANTING WAGON.

Mr. LESLIE W. WISHARD, Manager, Union Mill Co., wrote: Since the furrows made by the runners of a planting sled are not deep enough to reach the moist soil in a dry unirrigated field, we constructed a 3-wheeled wagon, with three regular furrow ploughs attached to its frame, and a pivoted front wheel which makes possible a very sharp turn at the end of the furrow. This arrangement made very good furrows and covered over an acre per hour, drawn by a 75 h.p. "Holt" caterpillar tractor. However, the frame of this wagon was not strong enough to withstand the strain of three furrow ploughs and was consequently abandoned for the time being.

PLANTING MACHINE.

Mr. L. D. LARSEN, mentioned that the new planting machine invented by Mr. MOLER[1] is, undoubtedly, the most outstanding new agricultural implement devised in the Territory for the industry during the past year. It plants cane either for irrigated or unirrigated conditions, and is easily the most highly perfected cane planter yet built. It is pulled by a tractor, and plants about six acres per day, either on contour or straight lines.

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[1] Patent applied for.

EFFICIENCY OF TRACTOR WORK.

Mr. J. S. B. PRATT, Jr., contributed some notes, the purpose of which he explained was to emphasize the importance of close supervision of tractor work on the plantations

Exact records should be kept, and it is surprising to observe the breakdown time between various makes and types of tractors and between different drivers, and thus actually determine the amount of work each would do. Operations during the first year of the tractor's life do not require to be subjected to much criticism, but reports show a surprising difference later on, and with different drivers.

Each driver makes a report every morning on the previous day's work, showing the number of hours occupied in particular operations (ploughing, harrowing, hauling cane, off-barring, cultivating, etc.), and also the time lost in delays, in travelling, and the like, and especially in breakdowns, the precise cause being stated on the sheet. The main figure wanted is "the percentage of breakdown of the total working time." One is surprised to find that by the accumulative action of 5 mins. lost in starting, a half-hour job in repairing a fan belt, a delay in changing spark plugs, and numerous daily troubles that the equivalent of a 20 per cent. "breakdown" or delay often occurs. Suppose this happens every day. In 250 working days, 50 working days, or nearly two months are lost, yet a great many of these troubles can be overcome by closer supervision. The reports have a psychological effect on the driver, and on the head luna.

There is no more practical way to obtain this effect than by the installation at small cost of a "Servis" recorder, or some other make of clock record, by means of which the driver knows that a "luna" is continually watching him. The forward motion of the tractor causes a small line to be scratched on the carbon record; which (it is true) could be altered by the driver if not locked, but it would soon be found out, especially by "the work done per unit of time." Several plantations in the territory have these on the trucks, and we have heard very little criticism of them.

These records should be kept up daily, and can be summarized by month very quickly. As each field is begun or each operation is changed, the amount of acres per day can be found, and accounted, and the gasoline and oil consumption obtained.

A movement has been initiated by influential inhabitants of St. Vincent, B.W.I., for the revival of the sugar industry of that colony, and Government co-operation is urged for the establishment of two or three small modern factories, costing say £50,000 each, each grinding cane from 650 to 800 acres of land per annum. It is considered that the revival of the sugar industry on modern lines is the best means of stabilizing the Colony's agricultural interests.

Japan is actively developing beet sugar manufacture in Hokkaido, the most northerly of the large islands composing her archipeligo, hoping thus to obtain a supply of sugar sufficient to render any importation necessary.[1] Both climate and soil are stated to be eminently suitable for beet cultivation. The Government are offering land to companies at low prices; farmers are being introduced from Japan proper; and a bonus system has been instituted for the inducement of high yields. Due to the low cost of labour and to the other favourable conditions prevailing, it is stated that beet sugar can be produced there at a lower price than in any other part of the world, and it is even predicted that in the future Japanese beet sugar will be competing with Javan cane in certain markets. Beet sugar manufacture is also being extended in Manchuria.

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[1] *Times Trade Supplement*, February 22nd, 1924.

Clarification of Juice in Hawaii.[1]

By W. R. McALLEP.

INTRODUCTION.

Clarification has undoubtedly received more attention in Hawaiian factories during the past two or three seasons than has any other phase of manufacturing operation. This study has been well repaid. For several reasons the increase in purity from mixed juice to syrup has been growing smaller; and undetermined losses in 1922 have been considerably reduced.

The technical considerations involved in the clarification process can now be more definitely stated than before, though information still remains incomplete. Some of these considerations briefly stated are as follows:

Lime and heat have a solvent effect on "cush-cush," thus adding to the impurities in the juice and reducing the recovery. Suspended matter should be removed from the juice as thoroughly as is practicable before clarification.

INVERSION AT HIGH TEMPERATURES.

Juices on standing develop acidity, the velocity of the reaction increasing rapidly with the temperature. We have never been able to hold juice at 212° F. for more than 4 to 6 hours without sufficient acidity developing for inversion of sucrose to take place; but at 180° we have frequently held juice for 22 hours without such a point being reached. This was formerly attributed to the action of lime on glucose. Experiments have furnished rather strong evidence, however, that under normal conditions this lime-glucose reaction is but a minor factor, if indeed one at all. The exact nature of the reaction is not yet known. Its explanation is probably involved in the so-called "buffer action" of many substances when in solution. The temperature of juices before concentration to syrup should not be allowed to drop below 160°, since bacteria, will develop if the heat falls below this point.

On holding juices at a high temperature, inversion of sucrose at reactions formerly considered safe has been detected, that is, at about neutrality, or very slight alkalinity to litmus. We have never detected inversion in similar experiments when the reaction of the juice was between a pH value of 7·4 and the neutral point to phenolphthalein, which pH value may be roughly defined as about midway between litmus and phenolphthalein neutrality. During the heating of the juice in clarification, some destruction of glucose can usually be detected. This is the case even when only sufficient lime has been added to bring the clarified juice to neutrality, or slight alkalinity to litmus. On holding the resulting clarified juice at high temperatures, however, no further destruction of glucose even at reactions as alkaline as neutral point to phenolphthalein can be detected. The above then defines what from the standpoint of sugar manufacture may be termed a "neutral zone." That is, at a point about midway between litmus and phenolphthalein neutrality, inversion of sucrose and destruction of glucose need not be feared, for these reactions in this "neutral zone" (if they take place at all) proceed at an extremely low velocity.

CLEARNESS OF SETTLED JUICE.

There is a definite point where a maximum increase in purity from mixed to clarified juice is secured; and there is also one where the clearness of the settled juice reaches a maximum, further addition of lime bringing about no improvement in this respect. These points usually coincide quite closely, though their exact location varies slightly in different juices. With but few exceptions, they both lie within the "neutral zone" as defined above.

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[1] Contribution to the Report of the Committee on the Manufacture of Sugar, Hawaiian Sugar Planters' Association, September, 1923, here abridged.

The volume to which the precipitated and coagulated material will settle, increases rapidly with increased amounts of lime; and in extreme cases can reach possibly half the total volume of the juice with the reaction of the clarified juice at approximately the optimum point.

The amount of phosphoric acid present is a very important factor affecting the possible clearness of the clarified juice. With ordinary clarification using lime and heat only, we have never obtained clear clarified juice with a deficient amount of phosphoric acid; while on the contrary, we have never failed to secure a clear juice by liming to the approximate point, in the presence of a sufficient amount of phosphoric acid. Adding phosphoric acid to the juice secures the same effect as if it were originally present.

Experimental work in connexion with the filtrability of commercial sugar has strongly indicated that the turbidity of imperfectly clarified juice is largely due to wax.

Applying these principles in practice has accentuated previously recognized defects in methods and equipment and uncovered other defects that were not previously clearly recognized. That this should be the case is to be expected, seeing that methods have been developed and equipment installed without as definite a knowledge of the technical considerations involved as we now have.

INSULATION OF TANKS.

One defect in equipment, thus disclosed in regard to the problem of avoiding deterioration in juices held over in the settling tanks during shutdowns, is an insufficient insulation of the settling tanks at many factories. H. S. WALKER, of Pioneer Mill Company, has reported that by reducing the temperature of juice over to 180°F., no appreciable loss through inversion was sustained, though no preservatives were used.[1] This method was tried at other factories with varying degrees of success.[2] Where it was not successful it has been found that the settling tanks were not sufficiently well insulated to keep the temperature of the juice above 160° and losses through bacterial action took place, which defect, in most cases, can be easily remedied. Dry bagasse is a very efficient insulating material and the cost of applying it is usually quite moderate. If the temperature drop is reduced to about 0·5° per hour, if the juice be over-limed so that after heating it will be about neutral to phenolphthalein, and if it be heated to 180°, little if any deterioration will take place during a 24 or even a 36 hour shutdown. This defect is then as a rule comparatively easy to remedy, and we can consider the problem of keeping juice during a shutdown of moderate length satisfactorily solved.

CONTROLLING THE REACTION.

Methods for controlling the reaction of clarification leave much to be desired. In the past litmus paper has been used almost exclusively. Expressing the results of clarification investigations in a form applicable to factory work has been most difficult, particularly as the desirable point is at a moderate alkalinity to litmus. Phenolphthalein is an improvement, the cold juice being limed to a slight alkalinity to this indicator, for when the clarification is controlled in this manner the juice will usually, though not always, be within the "neutral zone" as defined above. An improvement has been made in controlling the reaction of sugar liquors at Crockett Refinery, where some of the newer indicators are being used in connexion with colour cards. At present the method is perhaps too cumbersome for actual use at the liming station of the sugar factory, though it may be possible to so simplify it that it will be practicable.

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[1] *I.S.J.*, 1919, 611. [2] *I.S.J.*, 1922, 154. See also *I.S.J.*, 1923, 476.

During the past season efforts have been made in Hawaii to adapt a recording hydrogen-ion concentration indicator to sugar factory work. The apparatus works satisfactorily, but some alterations are still required to adapt the sampling device to routine conditions. When the difficulties are overcome, a continuous record of the exact reaction of the juice will be provided. Such a record has not been previously available.

AUTOMATIC LIMING DEVICES.

Closer attention to clarification has disclosed serious defects in the practice of liming the juice. Even though the correct total amount of lime is added, there is usually a wide variation in the reaction of the juice passing through the heater. It is the rule rather than the exception to find that juices emerging from the heater vary all the way from decidedly acid to litmus to strongly alkaline to phenolphthalein within the space of a few minutes. Any inversion of sucrose through heat and acidity, and any destruction of glucose or other organic matter by heat and excessive amounts of lime, will not be corrected, even though the juice when finally mixed in the settling tanks is at the desired reaction. Difficulties associated with the use of excessive amounts of lime have been reported from some factories when juices have been limed to what we have indicated as the optimum point, though laboratory experiments have strongly indicated that this should not be the case. Liming to the optimum point has usually required an increase rather than a decrease in the amount of lime used and no doubt with an increased amount of lime, an increased amount of overlimed juice passes through the heater. Two liming devices that overcome this difficulty and operate satisfactorily have been in use during the past season. One has been developed by the Oahu Sugar Company, the lime being added continuously at the mixed juice pump suction, and no difficulty has been experienced in liming the juice to exactly the desired reaction. The other device, used in connexion with the Petree process,[1] gives equally satisfactory results.

A straining device by means of which the juice can be passed through a very fine mesh screen has also been successfully developed by the Oahu Sugar Company; while a rotary apparatus which will pass the juice through a screen of 100-mesh, or finer, has been developed by Mr. S. S. PECK,[2] and has been successfully operated in at least two factories.

IRREGULARITIES IN FILTRATION.

Shortcomings in filtration practice and equipment are also accentuated when the clarification is conducted at the optimum reaction indicated by our experiments, for this reaction is more alkaline than has been the common practice and in consequence a larger volume of settlings must be filtered. Filtration difficulties are increased, not only because of the larger amount of material handled, but also because the proportion of liquids to solids in the settlings is increased. The volume of the settlings varies greatly with different juices. Probably also there are considerable variations in the filtration characteristics of seedlings from different juices even at a given ratio of liquids to solids. In some cases the volume and filtration characteristics of the seedlings are such that it is possible to remove a considerable part of the "cush-cush," also to lime the juice to the optimum point, and still to handle the filtration satisfactorily with the present equipment. On the other hand, there are many juices with which the volume of settlings is so large that it is hardly possible to lime even to litmus neutrality, on account of overtaxing the capacity of the filter-presses. Such juices have been considered refractory. They are usually, however, those capable of yielding the clearest clarified juices and the largest increases in purity.

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[1] *I.S.J.*, 1923, 72; 1924, 91.

[2] *Ibid.*, 1922, 31; 1923, 432, 466.

Steam Conservation and Evaporator Bleeding.

By P. H. PARR.

Under modern conditions, with long milling trains and heavy maceration, sometimes amounting to 40 per cent. on the cane, the steam requirements of a factory for heating and concentrating the juice are very much greater than when 11-roll milling plants and 10-15 per cent. maceration were the rule, whilst the calorific value of the bagasse is appreciably lower, owing to the extraction of combustible sugar, which is now often only 1 per cent. of the bagasse, instead of the former 4 or 5 per cent. The effects are an increase of 20 or 25 per cent. in the quantity of juice to be dealt with, from a given amount of cane and a reduction of something like 5 per cent. in the amount of steam generated by the combustion of the bagasse. The consequence is, that, except when crushing high fibre canes, a considerable proportion of auxiliary fuel is necessary, and therefore it becomes of the greatest importance to reduce the steam consumption in the factory as much as possible.

The necessity for obtaining the maximum possible results from a given quantity of steam is responsible for the employment of the quadruple effect evaporator, which is now standard in all but small factories, instead of the triple effect which was so common up to 10 or 15 years ago. The quadruple has the advantage of using about 30 per cent. less steam than the triple, but the steam consumption is much more sensitive to variations in the temperature of the entering juice, so that whilst the temperature of the feed to any evaporator should always be as high as possible, the point is of especial importance with quadruples. The steam consumption of a triple effect evaporator with juice feed at 150° F. is about 20 per cent. more than when the juice is supplied at the temperature of the first vessel (about 205° F. with 5 lbs. steam pressure), and the evaporation is about 5 per cent. less; whilst with a quadruple effect evaporator, the steam consumption under similar conditions is increased by about 30 per cent., and the evaporation is reduced by 7 per cent. The steam consumption of a quadruple with juice feed at 150° F. is almost exactly the same as that of a triple with juice feed at the temperature of the first vessel. From this it follows that, when once the juice has been heated to boiling point for defecation, every precaution should be taken to minimize the heat losses before passing to the evaporator; subsiders should be covered and thoroughly well lagged on sides and top; separate lagged tanks are better than nests; hot juice pipes should be covered with non-conducting composition; juice pumps lagged; and so on.

It is obvious that, from the point of view of steam conservation, the juice should be concentrated as far as practicable in the evaporator, where about 3½ lbs. of water are evaporated per lb. of steam used, thus leaving a minimum amount to be evaporated in the vacuum pans, where the steam consumption is about 15 per cent. more than the evaporation. A syrup density of 70° Brix is often mentioned as desirable, but syrup of such a high density is not easy to work in the pans, and 60-65° Brix is more usual; for high-grade plantation white sugars, the pan boilers prefer an even lower density, whilst syrup does not subside well much over 55° Brix, and this is a common syrup density where white sugars are made. This corresponds to an evaporation of 74·5 per cent. by weight, or 78·6 per cent. by volume, from juice at 14° Brix.

One of the most important methods of conserving steam, which has been in use in beet sugar factories for years, and is now becoming standard in the larger cane sugar factories, is to bleed steam from the first—and sometimes also from the second—vessel of the evaporator, and to use this for the first part of the juice heating. Steam used in the first calandria to produce lower pressure steam for juice heating is utilized at double effect when the bleeding is from the first vessel, and at triple effect when the bleeding is from the second vessel, whilst since the steam requirement for juice heating is more than 60 per cent. of that for the evaporator,[1] it is evident that a very appreciable saving in steam is possible by this means, even although all of the juice heating cannot be done by bled steam, owing to its temperature not being sufficiently high.

Where this method of bleeding steam from the evaporator for the purpose of juice heating is adopted, it at once becomes of considerable importance to estimate with reasonable accuracy the temperatures in the evaporator vessels, and the methods often adopted are not at all satisfactory. The old method of dividing the total temperature drop, from first calandria to condenser, equally between the vessels is of course hopelessly in error, although even to-day it still appears at intervals in articles on evaporators. For an ordinary evaporator with equal-sized vessels, results much nearer to the actual working values are obtained by dividing the total pressure drop into equal parts, but this method does not admit of the temperature of the juice feed being taken into account, nor of varying sizes of evaporator vessels, except in cases where the vessels following one from which steam is bled have heating surfaces reduced in proportion to the quantity of bled steam, so that the surface rate of evaporation remains constant.

A method which appears to give very fair results under varying conditions was developed by the writer in an article on *The Theory of Multiple Evaporators*,[2] in which it was pointed out that an application of the kinetic theory of gases leads to its being probable that the rate of heat transmission in an evaporator vessel will, to a first approximation, be given by $T = k \sqrt{p\,d}$; where T is the heat transmission, in B.T.U. per sq. ft. per hour per 1° F. temperature difference; p is the pressure, in lb. per sq. in., and d the density, in lb. per cub. ft., of the condensing steam; and k is a numerical constant, for which a value of 300 gives very fair average results, although somewhat on the low side. It is safe to add 25 per cent. to this value for most purposes, and for a perfectly clean evaporator, with good circulation, 50 per cent. or even more can be added. The values found for the temperatures in the various vessels are not affected at all by the value taken for k, and for the rate of evaporation, k can be adjusted so as to agree with the known results of the operation of any particular maker's evaporators.

Taking 300 as the value of k, then if we divide the latent heat of the condensing steam at any temperature by the corresponding value of $300 \sqrt{p\,d}$, we obtain the temperature difference, say D, necessary to condense 1 lb. of that steam per sq. ft. per hour. The values of D thus found, also the corresponding vacua or pressure, for temperatures from 100 to 260°F. are given in the accompanying table: they, together with other figures, were given in the article mentioned above, but the issue containing it was soon out of print, and cannot now be obtained, though the American Soc. M.E. will usually make photostat copies of articles at cost price.

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[1] *I.S.J.*, 1924, p. 12 *et seq.*

[2] *The Engineer*, February 18th, 1916.

Vacua, Pressure, and Temperature Differences to condense 1 lb. per Sq. Ft. per Hour.

Temp. °F.	Vacuum in. Hg.	Temp. Diff. °F.
100	28·0	66·6
101	27·9	64·6
102	27·9	62·7
103	27·8	60·9
104	27·7	59·1
105	27·7	57·4
106	27·6	55·7
107	27·5	54·1
108	27·5	52·6
109	27·4	51·1
110	27·3	49·6
111	27·3	48·2
112	27·2	46·9
113	27·1	45·6
114	27·0	44·3
115	26·9	43·1
116	26·8	41·9
117	26·8	40·7
118	26·7	39·6
119	26·6	38·5
120	26·5	37·4
121	26·4	36·4
122	26·3	35·4
123	26·2	34·4
124	26·1	33·5
125	26·0	32·6
126	25·9	31·7
127	25·8	30·9
128	25·7	30·1
129	25·5	29·3
130	25·4	28·6
131	25·3	27·9
132	25·2	27·2
133	25·0	26·5
134	24·9	25·8
135	24·8	25·2
136	24·6	24·6
137	24·5	24·0
138	24·3	23·4
139	24·2	22·8
140	24·0	22·2
141	23·9	21·6
142	23·7	21·0
143	23·6	20·5
144	23·4	20·0
145	23·2	19·5
146	23·1	19·0
147	22·9	18·5
148	22·7	18·0
149	22·5	17·5
150	22·3	17·1
151	22·2	16·7
152	22·0	16·3
153	21·8	15·9
154	21·6	15·5
155	21·4	15·3
156	21·2	14·9
157	20·9	14·5
158	20·7	14·1
159	20·5	13·8
160	20·3	13·5
161	20·0	13·2
162	19·8	12·9
163	19·6	12·6
164	19·3	12·3
165	19·1	12·0
166	18·8	11·7
167	18·6	11.4
168	18·3	11·1
169	18·0	10·8
170	17·7	10·6
171	17·5	10·4
172	17·1	10·2
173	16·8	9·95
174	16·5	9·74
175	16·2	9·53
176	15·9	9·32
177	15·6	9·11
178	15·3	8·90
179	15·0	8·70
180	14·6	8·50
181	14·3	8·31
182	13·9	8·13
183	13·6	7·96
184	13·2	7·79
185	12·8	7·63
186	12·5	7·47
187	12·1	7·31
188	11·7	7·16
189	11·3	7·01
190	10·9	6·86
191	10·5	6·72
192	10·1	6·58
193	9·6	6·44
194	9·2	6·31
195	8·8	6·18
196	8·3	6·05
197	7·9	5·93

Temp. °F.	Vacuum in. Hg.	Temp. Diff. °F.
198	7·4	5·81
199	6·9	5·69
200	6·4	5·58
201	6·0	5·47
202	5·5	5·36
203	5·0	5·25
204	4·4	5·15
205	3·9	5·05
206	3·4	4·95
207	2·8	4·85
208	2·3	4·75
209	1·7	4·65
210	1·2	4·56
211	0·6	4·47
	Pressure lb./in.²	
212	0·0	4·38
213	0·3	4·29
214	0·6	4·20
215	0·9	4·10
216	1·2	4·04
217	1·5	3·96
218	1·8	3·88
219	2·2	3·80
220	2·5	3·73
221	2·8	3 66
222	3·2	3·59
223	3·5	3·52
224	3·9	3·45
225	4·2	3·39
226	4·6	3·33
227	4·9	3·27
228	5·3	3·21
229	5·7	3·15
230	6·1	3·09
231	6·5	3·03
232	6·9	2·97
233	7·3	2·92
234	7·7	2·87
235	8·1	2·82
236	8·5	2·77
237	8·9	2·72
238	9·4	2·67
239	9·8	2·62
240	10·3	2·57
241	10·7	2·52
242	11·2	2·47
243	11·6	8·42
244	12·1	2·38
245	12·6	2·34
246	13·1	2·30
247	13·6	2·26
248	14·1	2·22
249	14·6	2·18
250	15·1	2·14
251	15·6	2·10
252	16·2	2·06
253	16·7	2·02
254	17·3	1·99
255	17·8	1·96
256	18·3	1·93
257	19·0	1·90
258	19·5	1·87
259	20·1	1·84
260	20·7	1·81

To illustrate the use of these figures, suppose we desire to find the temperature distribution in a quadruple with steam at 225° F. and condenser at 130° F. We must first assume a rate of condensation and, for a trial, will take 4 lb. per sq. ft. per hour. According to the table, steam at 225° F. requires a temperature difference of 3·39° F. to condense 1 lb. per sq. ft. per hour, so that for 4 lbs. there will be required a difference of 3·39 × 4 = say 14° F. (it is usually no use working to decimals of a degree), so that the temperature in the first vessel and the second calandria will be 225 — 14 = 211° F. For 211° F. we find $D = 4{\cdot}47$, giving the temperature of the second vessel as 211 — 4·47 × 4 = 193° F. Similarly, the temperature in the third vessel will be 193 — 6·44 × 4 = 167° F., and in the fourth vessel 167 — 11·4 × 4 = 121° F.. which is lower than the required 130° F. If we try a condensation rate of 3·8 lbs. we obtain 225, 212, 195, 172, and 133° F., which is very close to the required value. We may now increase the temperature drops in the ratio of 225-130 to 225-133, or 95/92, giving, finally, a temperature distribution of 225, 212, 194, 170, and 130° F. It is of value to compare these figures with actual working results, and Deerr[1] gives the results of the tests of five different quadruples, and the averages of the five are 225, 210, 197, 177, and 130° F., all of which are quite close to the values estimated above, whilst the estimations for the first two vessels, which are all that are ever bled, are within 3° F. of the average actual values, an agreement which is highly satisfactory for estimations of this nature.

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[1] "Cane Sugar," by Noël Deerr (Norman Rodger, London), p. 322.

Next we will consider the temperature distribution if the juice feed is at 150°F., instead of about boiling point as was assumed above, and if we consider that 72 per cent. of the juice is evaporated in the quadruple, or 18 per cent. in each vessel, then for each lb. of water evaporated in the first vessel there will be 100/18 = 5·55 lbs. of juice to be heated from 150 to (say) 205°F. Taking the specific heat of the juice as 0·91, the heating will require 5·55 × 0·91 × (205 — 150) = 278 B.T.U., and the evaporation will require 975 B.T.U., a total of 1253 B.T.U., calling for the condensation of 1253/962 = 1·3 lb. of steam in the first calandria to evaporate 1 lb. of water, or 30 per cent. more than with feed at boiling point. The actual steam consumption will be about 5 per cent. more in each case, due to radiation losses. After the first vessel it is near enough for most practical purposes to assume that the vapour from one vessel evaporates its own weight in the next, the self-evaporation due to the juice cooling just about counterbalancing the losses from radiation and increase of latent heat. Actually, the evaporation is slightly greater in the later vessels, but only by 2 or 3 per cent. in the fourth, and less in the second and third vessels.

For a trial, we will assume a condensation rate of 4·8 lbs. in the first calandria, and 4·8/1·3 = 3·7 lbs. in the others, when the temperature in the first vessel will be 225 — 3·39 × 4·8 = 209°F., that in the second 209 — 4·65 × 3·7 = 192°F., that in the third 168°F., and in the fourth 127°F., and adjusting the temperature drops to 130°F. gives, finally, 225, 209, 193, 170, and 130°F. as the temperature distribution.

It may be noted that, with boiling juice, the estimated (tabular) evaporation was 3·8 × 95/92 = 3·92, and adding 25 per cent. as before mentioned, we may expect an actual evaporation of about 4·9 lbs. per sq. ft. per hour under the conditions assumed: also the evaporation will be 4 lbs. of water to 1·05 lb. of steam, or 3·8 lbs. evaporated per lb. of steam. With juice feed at 150°F., the tabular rate of evaporation is 3·7 × 95/98 = 3·59, or, again adding 25 per cent., an actual evaporation of about 4·5 lbs. per sq. ft. per hour; whilst 4 lbs. of water will be evaporated by 1·3 + 5 per cent. = 1·37 lbs. of steam, or an evaporation of 2·9 lbs. of water per lb. of steam. The reduction of the juice temperature from about boiling point to 150°F. therefore increases the steam consumption of the quadruple by 30 per cent., and reduces the evaporative capacity by 8 per cent.

Differences in the sizes of the vessels are readily dealt with, it being merely necessary to use the proper condensation rate for each calandria. For example, if the vessels continually increase in size, as in some old evaporators, the relative surfaces being, say, 1·0, 1·2, 1·4, and 1·6, then the relative condensation rates will be the reciprocals of these figures, or 1·00, 0·83, 0·71, and 0·62; the temperature distribution, with juice feed at the temperature of the first vessel, will be 225, 209, 190, 166, and 130°F., and the average evaporation will be 4·6 lbs. per sq. ft. per hour, or 6 per cent. less than when all the vessels are the same size. From this it might be expected that with reverse grading of the vessels, the first being the largest, the capacity would be increased, but calculations do not confirm this, and show that, whilst nothing is lost by using large first vessels, nothing is gained either, when no bleeding is done.

We now come to the question of the temperature distribution when steam is bled from one or more vessels, and it is evident that if the following vessels are made smaller, so that the evaporation rate is the same in each vessel, then the temperatures will be exactly the same as in equal sized vessels without bleeding.

It is quite a common practice to proportion the evaporator vessels approximately on this basis, but often the proportion is far from exact, whilst steam can be bled from an evaporator with equal sized vessels just as well as from any other—bleeding merely alters the temperature distribution.

Suppose we have a quadruple with equal sized vessels, and wish to bleed 15 per cent. of the evaporation from the first vessel, then the evaporation rate in the first vessel being taken as unity, that in the other three will be 0·85. Taking juice feed at first vessel temperature, it will be found that the temperature distribution is now 225, 210, 193, 170, and 130° F., whilst the evaporation rate will be 5·4 lbs. per sq. ft. per hour in the first vessel, and 4·6 lbs. in the other three, an average of 4·8 lbs. This shows that, if desired, a considerable amount of steam can be bled from a standard evaporator, with only 2 or 3 per cent. loss of evaporative capacity, so that there is not the slightest difficulty in applying the bleeding method to any existing factory, so long as there is say 5 per cent. margin in the evaporator capacity.

Finally, we will estimate the working of an evaporator under conditions more nearly approximating modern practice than do those of the foregoing examples—though each one illustrated a definite point—and will consider a quadruple having vessels with heating surfaces in the proportions 1·0, 0·8, 0·6, and 0·6; 15 per cent. of the evaporation bled from the first vessel, and an equal amount from the second vessel; juice feed at 180°F.; steam temperature in first calandria 235°F. (8·1 lbs. per sq. in.); temperature in last vessel 120°F. (26·5 in. vacuum); evaporation 72 per cent. of juice.

Taking the relative total evaporation in the first vessel as unity, that in the second will be 0·85, and that in each of the other two 0·70, a total of 3·25, so that 30·8 per cent. of the total evaporation is done in the first vessel, and for each lb. of water evaporated in that vessel there will be 4·50 lbs. of juice to be heated. For a first approximation to the temperature drop in the first vessel, we may take it as 14 per cent. of the total, or 16°F., giving a temperature of 219°F. In order to heat 4·50 lbs. of juice, with a specific heat of 0·91, from 180 to 219°F., and then to evaporate 1 lb. of water with a latent heat of 966 B.T.U., there will be required 1·18 lbs. of steam at 235°F., with a latent heat of 955 B.T.U., to be condensed. The actual steam consumption will be about 5 per cent. more, or 1·24 lbs. per 1 lb. evaporated in the first vessel, or per 3·25 lbs. evaporated in the four vessels, so that the working results of the quadruple will be 2·62 lbs. of water evaporated per 1 lb. of steam to the first calandria, with 0·121 lbs. of steam bled from each of the first two vessels.

Taking the condensation rate in the first calandria as unity, that in the second will be 0·85 (1·18 × 0·8) = 0·900, and that in the third and fourth 0·70 (1·18 × 0·6) = 0·99. The tabular condensation rate will be found to be 5·50 for the first calandria, 4·95 for the second, and 5·40 for the third and fourth, whilst the temperature distribution is 235, 220, 202, 174, and 120°F. (8·1 and 2·5 lbs. pressure; 5·5, 16·5, and 26·5 in. vacuum). The 5·5 lbs. condensation rate in the first calandria corresponds to an evaporation rate of 5·5/1·18 = 4·75 lbs. in the first vessel, and adding our usual 25 per cent., it is reasonable to expect an actual evaporation rate of 5·95 lbs. per sq. ft. per hour in the first vessel, corresponding to 5·95 × 3·25 = 19·3 lbs. in the four vessels, from 1·0 + 0·8 + 0·6 + 0·6 = 3·0 sq. ft. of heating surface, or an average evaporation for the whole quadruple of 6·4 lbs. per sq. ft. per hour. As before mentioned, the actual rate of evaporation depends greatly on the condition of the tubes, and on the circulation, so that, under favourable conditions, considerably higher rates are obtained. The fourteen tests recorded by DEERR[1] all correspond very closely to $k = 570$, or to an addition of 90 per cent. instead of 25, equivalent to an evaporative rate of 9·7 lbs. in the above case. The writer has records of even higher values, but they are not usual for normal average working, and the quadruple that gives an evaporation of 6 lbs. throughout the whole crop is not doing bad work.

The methods described above may be applied equally well to the pre-evaporators now often used in front of the quadruples, and for steam pressures up to about 20 lbs. per sq. in., and evaporation rates up to about 8 lbs. per sq. ft. per hour, the results will usually be quite close to the actual working values. There are, of course, a number of other factors which enter into the question, such as the elevation of the boiling temperature as concentration proceeds, with the concommitant superheat of the vapour; the water film on the outside of the tubes, which has been dealt with by the writer;[2] the resistance on the liquor side of the tubes and so on; but for ordinary evaporators the approximation given by the use of $k\sqrt{pd}$ is sufficient for most practical cases, and the errors are much less than the variations produced by the condition of the tubes.

The temperature of the steam bled from an evaporator follows almost exactly that of the heating steam in the first calandria, so that it is of considerable importance to maintain a steady pressure in the exhaust main, or else the juice heating will be irregular. The best method of securing this steady pressure is to connect the exhaust to the live steam main through a reducing valve set for the pressure at which it is desired to maintain the former.

Steam bled from evaporators is most often used in the juice heaters, but it may be and quite often is, used in the calandria vacuum pans; steam at 5-8 lbs. from a pre-evaporator using steam at 15-20 lbs. is especially suitable for the calandria pans, and a considerable economy can be effected in this manner.

The remaining point of importance is as to the amount of steam to be bled for juice heating, and since, from a practical point of view, all of the juice heaters should be of the same size, the requirements will be quite definite. As an example, suppose the juice is to be heated from 80 to 215° F. by three heaters in series, the first supplied with steam bled from the second vessel of the evaporator at 200° F., the second with steam from the first vessel at 220° F., and the third with exhaust steam at 235° F. Referring to the article on Juice Heater Calculations,[3] and allowing a heat transmission of 120 B.T.U. per sq. ft. per hour per 1° F., it will be found that one sq. ft. per heater will deal with 15 gallons of juice (density 1·06, specific heat 0·91) per hour, the temperatures on leaving the heaters being 148, 189, and 215° F. respectively. Allowing 5 per cent. radiation losses, each lb. of juice will require 0·066 lb. of steam in the first heater, 0·041 in the second, and 0·026 in the third. The evaporation in the quadruple will be the 0·041 lb. bled from the first vessel, plus twice the 0·066 lb. bled from the second, plus four times the evaporation in each of the other two vessels; and since the total is to be 0·72, it follows that the evaporation per lb. of juice must be 0·244 lb. in the first vessel, 0·203 in the second, and 0·137 in each of the others. The steam bled from the first vessel will be 17 per cent. of the evaporation, and the steam bled from the second 1·6 times that from the first.

Under the above conditions, 1 lb. of steam to the quadruple will evaporate 2·4 lb. of water, and the total consumption of exhaust steam for heating and evaporating will be 0·326 lb. per lb. of juice. If all of the juice heating had been done by exhaust steam, and the evaporator worked in the usual manner without bleeding, the total steam required would have been 0·357 lbs., so that nearly 9 per cent. of steam has been saved on these two processes by bleeding, which is equivalent to about 5 per cent. of the total requirements of the factory, or sufficient to provide practically all of the power. For a factory using auxiliary wood fuel equal to 4 per cent. of the cane, this means a saving of fully 20 per cent. on the cost of wood, which is quite an important item, and as mentioned previously, a further saving is possible by using a pre-evaporator to supply steam to the calandria pans.

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[1] "Cane Sugar," by NOËL DEERR (Norman Rodger, London), pp. 326-7.

[2] *The Engineer*, May 27th, 1921.

[3] *I.S.J.*, 1921, pp. 675-677.

Clarification of Cane Juice.

By H. C. PRINSEN GEERLIGS, Ph.D.

On considering the clarification of cane juice from a general viewpoint, we perceive that its final object is two-fold, viz., to make the juice clear, as well as to make it light in colour. Further, we see that of these two requirements the former is the principal one, the latter being only of minor significance, and in most cases being already included in the first mentioned.

PHYSICAL NATURE OF CLARIFICATION.

Up to a short time ago, the chemical side of the question had claimed most attention in the study of clarification. Starting from the fact that lime is the universal clarifying reagent, applied either in small or in large proportion, and is capable of transforming the viscous, slimy and turbid raw juice into a limpid and clear liquid, the chemical reactions of lime on the various constituents of the cane juice have been the object of careful investigation and consideration. Under the spell of the idea that clarification by lime throws down not inconsiderable amounts of impurities, great value has been attached to the figures showing the increase in the quotient of purity as the outcome of clarification. Whenever a new clarifying agent was introduced (and everybody knows that this has occurred quite frequently), an enormous increase in that quotient was always said to be one of the salient advantages of the discovery.

It is, however, not clear which of the non-sugars of the juice may be removed by the application of the great variety of chemicals proposed ; nor is it easy to see how a relatively small amount of chemical could possibly precipitate great quantities of objectionable non-sugar on being added to the juice, Finally the analysis of the filter-press mud, in which the harmful or undesirable impurities ought to be present in a concentrated form, has failed to throw any light on the subject.

In consequence, we are forced to the consideration that the clarification of cane juice does not aim so much at the removal of a large amount of impurities as at effecting a radical change in the physical properties of some of the constituents of the juice.

FLOCCULATION OF THE COLLOIDS.

First of all, we are inclined to think that there occurs a change in the degree of dispersion of bodies present in the juice as colloids, which not only do not subside, but owing to their protective action, also prevent certain kinds of insoluble matter such as earth, clay, *bagacillo*, wax, air, etc., from settling or escaping. The properties of the mixture thus resulting account for the sticky and slimy character of the juice.

If these considerations are correct, the chief object of clarification will have to be directed towards changing the degree of dispersion of the colloidal constituents of the juice in such a way that they become insoluble and subside. As soon as the colloids are thrown down in this way, the insoluble matter held in suspension by them is allowed to subside, or to rise to the surface, according to its specific gravity, leaving the juice in any case clear and limpid.

Before making a choice between the different agents which promote the flocculation of the colloids, we have to ascertain the real character of the latter. In the literature of sugar cane, are found many statements that gums, pectins, albuminoids, etc., account for the stickiness and resistance against filtration of cane juice, but there is no certain proof that the bodies mentioned have to be considered as the real cause. Neither albuminoids nor gums, nor pectins, occur in appreciable proportions in the juice; and we, ourselves, feel inclined to adhere to the hypothesis of MÜLLER,[1] who believes a colloidal silicious compound to be the cause of the viscosity of cane juice.

Among the means generally in use to promote the flocculation of colloids the following may be mentioned here :—(1) Addition of an electrolyte; (2) Action of the electric current ; (3) Change in the reaction of the solution ; (4) Elevation of the temperature ; (5) Adsorption by surface-attraction using porous or flocculent materials ; and (6) Separation by centrifuging or ultrafiltration.

In this discussion it will be seen that the various methods of clarification in practical use may be classified under one or more of these headings.

ACTION OF ELECTROLYTES AND OF THE ELECTRIC CURRENT.

Addition of an electrolyte to the juice will be recognized at once not to be a very promising possibility, for if the quantity required is large, the expense will be prohibitive; while moreover the great amount of salts introduced will immobilize too much sugar in the final molasses and thus cause too great a loss. Small amounts of any electrolyte are surely useless, for if there existed a material which in small doses could cause the colloids of cane juice to flocculate, it must have been among the many hundreds of chemicals which have been recommended for use in clarification during the course of time. As it is known that none of these has been successful, we do not hold out any hope for the application of electrolytes for the purpose in view.

Better assistance may be expected from the electric current, although the results of manifold experiments in treating juices with electric currents of various degrees of intensity using all kinds of electrodes, combined or not with dialysis, have not been able satisfactorily to solve the problem.

CHANGE IN THE REACTION OF THE SOLUTION.

In our opinion the best results may be expected from the proper tempering of the juice, so that the exact point at which the colloids coagulate is reached. This tempering, combined with high temperatures, constitutes the well-known method of defecation which has been in use for centuries all over the world.

On adding continuously small amounts of milk-of-lime to boiling cane juice, and observing the appearance of the mixture after each addition, a precipitate is seen to arise already after the first portion, this increasing after further additions till it reaches its maximum. At the same time a gradual change in the character of the precipitate is observed. At first it is suspended in the juice, but gradually it becomes less bulky, subsides easily, and leaves the supernatant liquid clear. It may be seen that with further additions of lime the precipitate swells more and subsides less rapidly; but, at any rate, in every cane juice a point may be observed where the proper amount of lime brings along rapid and complete subsidation.

The determination of this point has offered great difficulties up to now because of the lack of a reliable and rapid method which enables one to find, at once, the real point up to which the juice had to be tempered in order to get the best results. In many cases the reaction to litmus or turmeric paper was considered to be the criterion, or the filtered juice was titrated with N/28 acid, and a certain alkalinity was adopted for general use, but in most cases the degree of tempering was ascertained in an empirical way for the juice under treatment. Whenever canes having a different constitution to those previously treated were being crushed the point in question had to be ascertained anew, which rendered proper tempering a rather uncertain operation.

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[1] *I.S.J.*, 1921, 579.

It has, however, been proved by GEBELIN[1] and others that the proper point of flocculation of the colloids in cane juice stands in direct connexion with the hydrogen-ion concentration of the juice. After having determined once and for all empirically, either in the factory or in the laboratory, at which hydrogen-ion concentration the subsiding of the hot-tempered juice is at its best and completest, the only thing to be done in future is to temper the juice till it has attained the required potential.

This point may very easily be determined by means of slips of paper soaked in solutions of one or other of the many colour reagents which have come in use after the publication of the experiments of LUBS and CLARK.

GEBELIN showed that the optimum tempering point lies at a pH of 7·2 at ordinary temperature; and, as in that case the juice is almost neutral, there is the great advantage that no action of alkaline bodies on the reducing sugars is to be feared, coloration due to that occurrence thus being excluded.

ADSORPTION BY SURFACE ATTRACTION.

This simple defecation process permits a good subsiding of the juice, so that the supernatant clear liquid may be syphoned off from a muddy layer; but this clarification is not thorough enough to yield a juice fit for the manufacture of white sugar. In order to clarify a juice for that purpose, we avail ourselves of the property of colloids to adhere to porous or flocculent materials introduced in the juice to be clarified.

One instance of this property, extensively applied nowadays, is the use of infusorial earth ("Filtercel"), and of various kinds of vegetable carbons, which absorb the colloids and carry them to the bottom of the settling tanks.

The sulphitation and the carbonatation methods are based on the same principle of removing colloids by surface attraction. More lime is added to the cane juice than is necessary for the optimum pH, after which the excess of lime is removed by either sulphurous or carbonic acid till the proper range of hydrogen-ion concentration is obtained.

These acids form insoluble lime salts in the liquid, which, while forming and subsiding, allow the colloids to become incorporated in their interstices, thereby leaving the juice clear and limpid. Alternatively one can sulphite the juice first to a distinct acid reaction, and lime back to the exact pH, in which case the precipitate of calcium sulphite effects the same purpose of attracting the colloids.

It is seen from these instances that every method in practical use corresponds to one or to a combination of some of the suggested means of causing a change in the degree of dispersion of the colloids. Notwithstanding the seemingly chemical character of many methods, their action is only a physical one, so that in reality no great quantitive changes take place during clarification.

This explains why generally the quotient of purity of a clarified juice does not differ greatly from that of the original raw juice. Very little non-sugar has been eliminated from the juice, and therefore the quotient of purity does not undergo a great increase.

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[1] *Louisiana Planter*, 1923, 71, No. 9, 172.

[2] W. MANSFIELD CLARK, "The Determination of Hydrogen Ions." (WILLIAMS and WILKINS Co., Baltimore, U.S.A.). 1922. See *I.S.J.*, 1923, 262.

It is true that sometimes instances are mentioned of a very great increase or even a decrease. In such cases it has been found that either very heavy substances (as sand or clay) or very light ones (as air) were held in suspension by the colloids of the juice, thus influencing the readings of the Brix hydrometer with the aid of which the quotient of purity is determined. As soon as the colloids flocculated and became unsoluble, they released the suspended bodies, which then either settled or escaped, their delusive action on the Brix hydrometer thus being eliminated.

As the colouring matter of cane juice is one of the colloids, any method for removing these bodies serves at the same time as a decolorizing device, which is quite sufficient for the manufacture of raw sugar.

SEPARATION BY CENTRIFUGING AND ULTRA-FILTRATION.

Finally, it remains to discuss the methods proposed to remove the colloids by simple separation from the liquid. Juice from the mills passes through strainers having a gradually decreasing width of mesh, which keep back the course pieces of bagasse. Further, it is conducted through a sandbox, where heavy particles as sand, clay, etc., are separated, but, although these devices keep back not unimportant amounts of impurities, yet they are unable to remove colloids. We know of centrifugals by HIGNETTE, KÖPKE, SANDFORD and others, in which the limed juice, either cold or warm, is separated into a hard crust of filter mud and a clear juice, but that is not what we mean here.

The centrifugal invented by MAUSS[1] for use with raw juice claims to remove 96 per cent. of the floating and suspended material from the juice. It comprises a drum composed of a number of separable sections of conical form, which are pressed apart axially by springs, the raw juice being introduced through a pipe, and the solids deposited in the spaces, the clear juice escaping by a channel at the upper end of the drum. After running the machine until a certain amount of solids are deposited in the chambers, the supply is stopped, and the drum sections separated. The fully separated solids escape through the outlet, while the partially separated solids and liquid are carried back to the supply vessel. In the case of a machine in which the diameter of the drum is 2 ft., the speed is 1000–2000 revs. per min.

A second machine for the removal of colloids is the ultra-filter constructed by PLAUSON, which may remove particles having a diameter of one millionth part of a millimetre. It consists of a perforated metal cylinder, covered at the outside by perforated rings or plates which may be tightly pressed together by screw bolts. The perforations consist of elongated slots, adjacent plates being arranged so that the slots of one are at right angles to those of the other. This arrangement forms a filter element in which openings of the pores may be varied at will only by changing the position of the screw bolts. A slimy layer is deposited on the interior side of the cylinder, and is kept at a constant thickness by a worm with decreasing pitch towards the discharge, which constantly scrapes off the dirt only maintaining a thickness of 1–2 millimetres, this in fact constituting the proper filtering surface. The cylinder is therefore internally coated with a felt blanket. The juice is forced into the drum under heavy pressure; passes the filtering layer; and leaves the cylinder through the pores; while the dirt scraped off by the worm is pushed outside through a trap.

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[1] *I.S.J.*, 1921, 592.

Boiler-room Equipment.[1]

BY ALVAH A. SCOTT.

Mill engineers in the Territory of Hawaii were invited to state what they had to say in regard to recent improvements of which they had had experience relating to boiler-room equipment and boiler operation, and the following is a summary of some of the replies received :—

Mr. JOHNSON, of Wailuku, wrote that a separate Venturi hot water meter installed on the boiling-house boilers " has furnished indisputable evidence of the rate and regularity of steam being drawn from these boilers during every hour of the day and night shift, and furnishes the engineer with a check on the operating efficiency of the plant." The separate determination of the steam consumed by the boiling-house may be a more or less common practice ; but, if not, it would probably aid in economizing in steam when this is an important factor by localizing the points of maximum steam consumption. Definite information as to the steam consumed by the crushing plant and the boiling-house separately removes a possible cause of friction between the engineer and boiling-house staff, which is liable to occur when fuel economy is the watchword.

Mr. DANIELS, of Pioneer Mill, draws attention to a method of handling excess bagasse when the fire-room gets filled. He installed an 8 in. blower driven by a 5 h.p. motor at 3065 revs. per min. to blow the surplus trash over into a vacant plot 200 ft. away, the blower being fed automatically by a chute connected to the main carrier. At the end of the grinding season all the low grades were boiled off, using this trash as fuel by blowing the pile of approximately 200,000 cub. ft. back to the fire-room, through a 16 in. pipe with an 18 in. blower driven by a 50 h.p. motor at 2100 revs. per min. Not many plantations are blessed with this extra amount of fuel, but the above suggests a method of solving the problem if one is not prepared to bale the trash. Pioneer Mill intends installing a press in the future.

Mr. DUNCAN, of Olaa, gives his experience in securing a heavier blanket over the grate bars by a change in the angle of same. In connexion with the burning of molasses, he comments that all his molasses is burned by spraying it on the bagasse as it leaves the last mill, but the molasses is the cause of clinker. He has also tried burning it with the use of a burner, similar to an oil burner, but with no better results. Several mills are burning their molasses in a separate furnace, using no bagasse, but a few interesting points for discussion would be ; What is the advantage of this method over that of burning molasses and bagasse together ? Is the total heat recovery greater or less by this method than the combined method ? What percentage of the total steam is generated by the molasses alone ?

Mr. JOHNSON, of Wailuku, states in connexion with burning molasses that they " have been experimenting to some extent on burning waste molasses in conjunction with bagasse " ; and have found " that by applying the molasses, heated to about 140°F., in a fine spray over the bagasse as it leaves the last mill " they " experience very little difficulty in the furnaces with clinkers or burnt grate bars." In other factories where molasses is mixed with the bagasse before burning, there is less trouble with clinker if there is an opportunity for the molasses to become well mixed with the trash before reaching the furnace.

Mr. DUNN, of Honomu, remarks that the only addition to fire-room equipment which he has made is the installation of a boiler feed water filter. This filter was designed by him and consists of two identical units which can be used in series, in parallel or singly. This allows of one unit being cut out and the filtering medium changed without shutting down the whole installation. The filtering medium used is excelsior, which is contained between perforated plates, one top and one bottom forming a cartridge which can be lifted out bodily for changing.

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[1] Summary of a Report presented to the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1923.

Mr. DUNN also calls attention to a safety device, for recording water levels in boilers, which makes a written record of the water in the boiler throughout the 24 hours, and in addition rings a bell whenever the level is either too high or too low. A mechanically operated pen draws a red ink line on a circular, clock-driven chart, and this record indicates graphically all the important facts which need be known regarding the care the boiler is receiving. The red line shows exact time when boiler was 'cut in' and 'cut out,' when it was banked for the night, when it was 'blown off,' and when in operation. Foam in the boiler actuates the bell signal in the same way as would low water, and the ringing will continue until this undesirable condition is corrected. The water gauge is illuminated sufficiently to make its markings visible 50 ft. away. If such an instrument will do all the inventor claims, it will minimize dangers in steam boiler operation, and lower insurance rate materially. Such a device seems to be almost a necessity, particularly where unskilled operators are employed.

Mr. HUGHES, of Hawaiian Commercial and Sugar Co., offers the following interesting contribution, which touches on many points which should be of interest to all:—

During the past season, operations were on carried without the use of oil as extra fuel, this being an improvement here over previous years' work. This improvement we attribute to the burning of waste molasses; changes in the furnaces, which have allowed a more efficient combustion of the bagasse; converting two oil burning furnaces into bagasse furnaces, thereby adding two 300 h.p. boilers to the high pressure steam line; saving of heat due to the Petree process eliminating the mud press station; and saving of heat due to the Dorr clarifiers.

When extra fuel was required, we used molasses in conjunction with the bagasse. Owing to the limited space available for the storage of surplus bagasse fuel, we did not accumulate as much surplus as we might have. The surplus could, in turn, have been used for drying-off purposes at the end of the season, but during this period wood and molasses were used.

This extra fuel was required only when the following conditions prevailed: When grinding at a very low rate of speed, so that an insufficient supply of bagasse entered the furnaces, stoppages due to no cane, breakdown delays, and choking of the mills due to the large quantity of juice and mud returned to the mills from the clarification system. Six furnaces were arranged with molasses burners; and, when required, any number of these furnaces could be supplied with molasses as extra fuel, the furnaces being of the regular bagasse or Dutch oven type.

A small amount of bagasse was fed into the furnaces, about one-third of the quantity that would be used when firing with bagasse alone, while the molasses was fired through the burner from the front end directly above the fire-box. Live steam was used to atomize the molasses and exhaust for heating it to a temperature of 170° F., a pressure of 75 lbs. being maintained at the burner. The molasses burner used was a simple combination of pipes, arranged similar to that commonly used for oil burning, provided with a distributor head to which the steam and molasses piping is connected. The boiler tubes were blown out with a steam hose every eight hours, to remove the deposit of potash which was finally collected at the flue uptake, a door being provided for that purpose.

When all available bagasse storage space was filled with surplus bagasse, an outside electrical load of 300 k.w. to 600 k.w. was taken over by the mill plant in addition to the regular mill load. This extra load was taken care of regardless of the amount of cane on hand, and throughout Sunday shutdowns, the load dropping considerably on Sundays. While carrying this extra load, and the mill grinding at the rate of 110 to 120 tons of cane an hour, it became necessary at times to open up a 12 in. exhaust valve to the atmosphere in order to use up steam. With the grinding rate in excess of 95 tons an hour molasses would not be required.

A change in all the bagasse burning furnace grates proved to be a beneficial one. Bagasse, when fed into the surface, takes the shape of a long thin wedge, with the sharp end lying at the top of the step ladder grates. At this point the layer of fuel is very light, and a good draft quickly removes the fuel from the grates, thereby allowing the air to short circuit through this space, while the heavier layers of fuel lower down in the furnace remained a smouldering mass until the upper grates become covered again.

To remedy this condition, the air-spaces between the slanting, or step ladder grates, were blanked off at the upper end, to prevent dislodgment of the thin layer of fuel at this point. The floor, or flat grate area, was increased in proportion to the decrease in area of the step ladder grate. The free space, or space between the floor grates, was considerably increased, as was the space under these grates, this being done to prevent accumulation of ash under the floor grates from blocking off the air passage way.

We found this to be a great improvement. The bagasse burned freely and evenly, maintaining a higher and more uniform temperature as well as a more uniform record of CO_2, indicating a more efficient combustion of the fuel.

Two 300 h.p. boilers with a combined heating surface of 6345 sq. ft., formerly equipped with oil burning furnaces, and used as boosters whenever the demand for additional steam warranted, were added to the high pressure line as live units, as continuous generators, by changing the furnaces to the bagasse burning type. With this change made, we removed all oil burners, and likewise the temptation to open up the oil, which the firemen had become so accustomed to doing that they thought it impossible to get along without it.

The Petree process and Dorr clarifier are responsible for a great saving of fuel, by their eliminating the filter-press and mud-press stations. We had thirteen 34 in. frame mud-presses in operation, and eight 34 in. frame clarified juice filter-presses, which, with their large radiating surfaces and hundreds of draw-off cocks, liberated a tremendous amount of heat. The clarified juice now enters the first cell of the evaporators at an increase of 18 to 20° F. over the old system. The immense benefit from the wonderfully improved clarification was reflected in the boiling of both commercial and low-grade sugars. All sugars dried more rapidly and with less effort, this being especially noticeable in handling the low grades, so it is clearly obvious that a considerable saving of steam was effected here.

The Peck strainer is without a doubt responsible for a good share of the saving at this station, by the strainer removing practically all the "cush-cush" from the juice before liming and heating takes place. The strainer removes a large percentage of very fine bagasse that would pass through a 100-mesh screen, indicating that the cake of "cush-cush" deposited on the periphery of the screen acts as a very fine filtering medium. All this "cush-cush" removed by the strainer is returned to the mills and adds to the fuel supply.

The Beet Sugar Industry in Germany, Czechoslovakia, and Hungary.

The Commercial Secretary at Berlin (Mr. J. W. F. THELWALL) has forwarded to the Department of Overseas Trade an extract from the *Frankfurter Zeitung* of recent date, which states that the Association of the German Sugar Industry sent out its usual enquiries to sugar factories from the 2nd to the 12th January. Of the 268 factories which work-up beet into sugar (last year 264), the figures of two works had to be estimated, and those of other factories which did not reply ascertained from trade journals and other sources.

Factories in operation.		Beet worked up, tons.		Sugar produced, as Raw Sugar, tons.	
1923-24.	1922-23.	1923-24	1922-23.	1923-24	1922-23.
264	263	7,284,900*	9,372,226	1,130,420*	1,455,756.

As regards sugar for consumption, the production is estimated at 1,017,378 tons in 1923-24, compared with 1,310,180 in the preceding year. The sugar content 'of the beet amounts to 15·31 per cent. on an average, as compared with 15·5 per cent., the October estimate, and 15·4 per cent. last year.

The Commercial Secretary at Prague (Mr. E. C. D. RAWLINS) informs the Department of Overseas Trade that according to local press reports of recent dates Czechoslovakia produced during October and November, 1923, 864,678 tons of sugar, of which 79,870 tons are destined for home consumption and 201,095 were exported as follows :—50,096 to England, 62,340 went to Hamburg, 24,965 to Switzerland, 22,207 to Austria, 21,022 to Italy. France and Yougoslavia participated in these exports with 500 and 700 tons and further orders from these countries are expected.

Up to the end of December, 1923, 9·6 million metric quintals of raw sugar were produced. The previous year 7·4 million metric quintals of sugar were produced, the production during 1923 being almost 2¼ million metric quintals in excess. As the 1923 sugar season has not yet ended, it is expected that production will reach at least 10 million metric quintals of raw sugar.

The British Commercial Secretary at Budapest (Mr. R. J. C. HUMPHREYS) informs the Department of Overseas Trade that the 1923 crop of beet, now in progress, is conservatively estimated at 100,000 tons of sugar, of which 60,000 tons is required for domestic consumption, leaving a surplus for export of 40,000 tons which at present London market prices equal roughly £800,000. The quality of the beet and the sugar content are said to be good, although the autumn drought adversely affected the size of the root. The following table compares the acreage sown and quantity of beet raised in comparison with 1922.

Area sown in cadestral yokes.		1923 Crop in metric tons.	1922 Crop in metric tons.
1922	62,598	881,000	711,000
1923	94,728		

It is of interest to note that within the boundaries of the former Kingdom of Hungary there were 30 factories which in 1913 produced 590,000 tons. New Hungary has 13, the principal one of which is situated within 40 miles of Budapest. Most, if not all, of these sugar factories are controlled by one or other of the principal banks which finance the crop with or without the aid of foreign connexions.

There exists a considerable demand for Hungarian sugar in the Levant and the East, but it is likely that some portion will find its way to the London market.

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* Estimates.

Correspondence.

THE TEMPERATURE OF CONDENSING WATER.

THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—Twenty years ago a vacuum in the last vessel of the evaporator, and in the pans, of 24-25 ins. Hg. was considered quite satisfactory, and 26 in. was exceptionally good, but it has been found that a higher vacuum in the pans, with the consequent reduction of the boiling temperature, both facilitates the control, and improves the yield, so that, at present, the tendency when designing the condensing plants, is to aim for a vacuum of about 27 in.

With the higher vacua now desirable, the temperature margin between the vapour and the injection water is considerably reduced, and it becomes of great importance to know accurately the temperature of the latter, and, when enquiries are made, it is at once found that practically no reliable data are available.

On asking factory engineers as to the water temperature, and as seen in a number of modern specifications, the only figure given is the maximum, usually 85, 90, or even 95°F. according to circumstances; but nothing is said as to the period during which this maximum continues. Usually it is one that is seldom attained, and only continues for a few days, and it is not commercially efficient to put in a condensing plant to deal with maximum conditions which seldom occur, and do not endure. It is far better to design the condensing plant to deal with the mean conditions, and to allow the vacuum to fall a few tenths during the period of maximum water temperature.

The condensing conditions in sugar factories are in a very critical range, where small differences in the water temperature mean great differences in both water quantity and vacuum pump displacement. It may be well to illustrate this point by a few definite figures, to clarify the position. Taking a vacuum of 27 in., and a counter-current barometric condenser with a dry air pump, then, with injection water at 80°F., there will be required, per 1000 lb. of vapour, about 34,200 lb. of water, and an air pump displacement of 1925 cub. ft. If the water temperature increases to 90°F., then to maintain the same 27 in. vacuum, the water supply must be increased to 51,300 lb., or by 50 per cent., and the air pump displacement must be increased to 3160 cub. ft., or by about 65 per cent. At the same time, the old quantity of water, and the old vacuum pump, will still give a vacuum of about 26½ in.

These figures show that, in order to maintain the full vacuum under maximum conditions requires a condensing plant very much larger than does one designed for the mean conditions; and it is to be noted that a condenser must be maintained reasonably full of water spray, or else hot vapour will pass to the air pump, at once destroying the vacuum, so that, with a large condenser designed for maximum conditions, an undue amount of injection water will be required for normal conditions; and from these considerations it would appear to be most economical to design the condensing plant for slightly above normal conditions, and to sacrifice ¼ or ½ in. vacuum during the week or two of maximum water temperature.

I think that the above is sufficient to show that a knowledge of the temperature of the injection water is of vital importance for the best design of condensing plants, and I have so far been unable to obtain much information. I have been in communication with the British Meteorological Depot, the U.S.A. Geological Survey, the Mauritius Station Agronomique, etc., but there is practically no information available as to water temperatures in sugar cane districts. I have tables for the Nile, Amazon, Congo and Mississippi, but they do not help.

I would suggest that if a few engineers of sugar factories, in any and every part of the world, would take daily readings of the water temperature, during the whole of the grinding season, it would be of great value to many, and would not be much trouble to them. If they would take these water temperature readings, at the same hour each day (as the water temperature varies but little during a day, the particular hour is of little importance, though probably about 9 a.m. or 9 p.m. is most representative) and forward them to me through the Editor, I shall be very pleased to collate them, and to reduce them for publication. I address this appeal quite as much to the engineers of small factories in out-of-the-way parts of the world as to those of large Centrals.

Where cooling towers or ponds are used, the temperature and amount of both supply and pond water should be given, and also the temperature of the tail water from the condensers. Where possible, shade air temperatures should be given, and air humidity figures would also be of value, but few engineers will have the necessary apparatus in order to determine this last.

Any definite information on the subject of injection water temperature and its variation, in any of the sugar producing countries, will be of value, and, if forwarded to me, I will see it is made available for general use.

Yours, etc.,
P. H. PARR.

Publications Received.

Rohstoffe, Erzeugnisse und Hilfsprodukte der Zuckerfabrikation. By Edmund E. O. von Lippmann. Reprinted from Lunge-Berl's "Chemisch-technische Untersuchungsmethoden." (Julius Springer, Berlin). 1924.

Lunge-Berl's "Chemisch-technische Untersuchungsmethoden" is a standard work for the description of methods of analysis used in most of the industries in respect of raw materials, products in process, and finished articles. It is recognised as a publication of particular value to the industrial chemist, and is now being issued in its 7th edition. Dr. VON LIPPMANN (as in the previous editions) has prepared the section which deals with the sugar industry, and his name attached to a contribution of this kind is recognised among chemists generally as being of the nature of a hall-mark of excellent writing. A considerable amount of information has been compressed by him into the space of some 117 pages, which information treats of methods for the examination of the root; raw and clarified juice; waste and sweet waters; pulp and press-scum; thick juices and syrups; massecuites and sugars; molasses and waste products; and materials used in manufacture; together, with a short section dealing with the cane sugar industry, this latter being quite a brief outline. Copious foot-notes are given throughout this contribution, which enable the reader to consult the original articles relating to the methods described, or give him the opportunity of obtaining further information on points, which, owing to the restrictions of space, receive only brief mention. In the main, Prof. VON LIPPMANN's section retains the same form as in the previous edition, but he has of course brought it up to date by a few additions or emendations here and there, as in the case of the recent work done on the determination of invert sugar by BEYERSDORFER; double polarization by JACKSON and GILLIS; fine grain by KALSHOVEN and HELDERMAN; and the like. This monograph is one to which those reading German would naturally turn for information on the examination of beet products, so clearly and precisely is it written.

Chemical Synonyms and Trade Names. By William Gardner. (Crosby, Lockwood & Son, London, E.C.4.) 1924. Price: 25s. nett.

This is a dictionary containing 14,000 chemical terms, trade names, chemical synonyms, and names of substances to be found in commerce at the present day. It is a work that is likely to prove of distinct value to the chemist, who will use it frequently for ascertaining information regarding trade names (which are often troublesome to trace); and still more frequently by the business man, who often experiences difficulty in regard to chemical nomenclature. A wide field is covered, including as it does words relating to minerals, dyestuffs, explosives, pigments, drugs, alloys, commercial chemicals, and materials in common use. But useful as the book is, we suggest that its value might be enhanced considerably (and incidentally its sales much increased) by giving information regarding the nature of the principal chemicals of commerce in regard to fire risk or shipping regulations, which information in a handy form would certainly be greatly appreciated by brokers, exporters, insurance agents and others engaged in chemical commerce.

Brevities.

During 1922 the sugar exports from Peru were:[1] raws 257,354 metric tons; and whites, 16,745; while the domestic consumption is reported to have been 44,000 tons.

During 1922, Japan exported 1,414,133 piculs of refined sugar having a value of 19,092,029 yen.[2] That going to China amounted to 1,292,196 piculs, its value being 17,316,283 yen.

In regard to the sugar crop in Natal,[3] it is now estimated that, instead of the 195,000 tons previously anticipated, the output will be at least 200,000 tons. It is believed that had it not been for the severe drought of last year the figure might even have reached 250,000 tons.

In Mr. Farnell's recent contribution on the pectic substance of cane fibre, the[4] word "pectins" should have been printed as "pentosans," in the following sentence (page 623, 8th line from the bottom): "it is now known that alcohol precipitates in part the soluble *pectins* (principally xylan) contained in the juice."

Poland during the 1923-24 campaign produced 365,000 tons of sugar (in terms of white), of which 140,000 tons is available for export.[5] Her *per capita* consumption (with a population of 28,000,000) is estimated to be only 7·8 kg. (17·2 lbs.). In all there are 76 factories, 70 of which adhere to the Association of Sugar Manufacturers. Owing to the depreciation of the Polish mark, prices are now quoted in Swiss francs, and since January 1st of this year the consumption tax has been fixed at 35 francs per 100 kg.

In Italy there are now 40 sugar factories having a daily capacity of 40,000 tons of roots, and 12 refineries having a daily output of 200 metric tons of sugar, the total capital invested amounting to about 400,000,000 lire.[6] In 1923 the acreage under beet cultivation was 223,200. Several new factories are being built, and there is a prospect that in a few years' time the output will leave a margin for exportation. At present the price of refined sugar in that country is high, viz: 6·40 lire per kg. retail (about 6½d. per lb.), due to the heavy excise duty of 300 lire per quintal (nearly 3d. per lb.). The *per capita* consumption is about 17·2 lbs.

Dr. H. C. Prinsen Geerligs recently translated for the *Archief* the valuable paper by J. H. Lane and L. Eynon on the determination of reducing sugars with the use of methylene blue as indicator, which was published in these columns.[7] He remarked that he had applied the method to sugars and syrups, and had been very well pleased with the great accuracy with which reducing sugars can thus be determined, even in the darkest molasses. Coming from such an authority as Dr. Geerligs, this should be a sufficient recommendation to chemists to consider the adoption of this convenient and accurate procedure.

At the Glenwild Factory, La., Mr. Irving H. Morse has conducted experiments showing the value of a thorough admixture of juice and lime on the elimination of impurities,[8] which is to be realized by using his clarifying apparatus described a few years ago.[9] Four of these tanks were arranged in series, so that mill juice from a reservoir entered at the bottom of the first, overflowed at the top through a pipe into the bottom of the second, and so on. In this apparatus the milk-of-lime is dropped on a revolving disc, which causes it to be thrown off into the juice in the form of a spray, while the juice itself in the tank is agitated by means of a cone mixer which is rapidly rotated by means of a motor. A perfect admixture of juice and lime is said to be the result of this arrangement, and by using the four tanks in series the juice flowing through could be accurately controlled in respect of its final reaction. Analyses made during these experiments are said to have shown that 26·7 per cent. of non-sugars had been eliminated, and that the purity had been raised from 80·02 to 84·59°, a gain of 4·57°.

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[1] *American Commerce Reports Supplement*, 77,511, 23-1.

[2] *American Commerce Reports Supplement*, 77,989, 24-1.

[3] *S. A. Sugar J.*

[4] *I.S.J.*, 1923, 630-636.

[5] From a report circulated by the Association of Sugar Manufacturers in Poland, dated February 4th, 1924.

[6] *American Commerce Reports*, January 28th, 1924.

[7] *I.S.J.*, 1923, 143-149.

[8] *Facts about Sugar*, 1924, 18, No. 5, 105.

[9] U.S. Patent, 1, 311, 831; *I.S.J.*, 1919, 585.

Review of Current Technical Literature.[1]

COMPARATIVE AMOUNT OF MINERAL MATTER ADSORBED BY BONE CHAR AND BY VEGETABLE CARBON. *Paul M. Horton and P. T. Sengson.*[2] *Industrial and Engineering Chemistry, 1924, 16, No. 2, 165-167.*

Conflicting conclusions have been arrived at in regard to the relative power possessed by bone char and vegetable carbon of adsorbing mineral matter from the solution of sugar undergoing treatment; but, as the results of their experiments, the authors believe that to some extent the divergent opinions may be reconciled. Their method of working was to reflux the char or carbon with a 15° Brix solution of molasses for an hour, allow the char or carbon to subside, filter, wash the char or carbon on a Buchner funnel with hot water, and lastly to ascertain the amount of ash in the char or carbon by incineration in an electrically-heated muffle furnace kept to 650 to 700°C. In one series of experiments, they worked with equal volumes of the char and carbon, and in another with equal weights. With equal volumes, figures were obtained indicating the bone char to be approximately five times as efficient as vegetable carbon ("Norit") in removing ash from solution. When equal weights of the two materials were used, the results taken as a whole were again in favour of bone char. In the case of the bone char, the amount of ash adsorbed is constant, and independent of the weight used; whereas in that of "Norit" the ash percentage increases as the weight of this preparation increases, the amount of the molasss solution remaining the same. Results were obtained suggesting that the ash adsorbed per unit weight of char or carbon is a function of the total amount of insoluble ash present in the char or carbon. Anyway, it is now known that it is the mineral skeleton of bone char that removes the ash. Data obtained by the authors appears to prove that 1 grm. of bone char containing 0·834 grm. of mineral matter should adsorb as much salt from solution as 11 grms. of "Norit" containing 0·832. In conclusion, it is thought that the divergent opinions regarding the relative power of bone char and vegetable carbon in respect of salt adsorption may be due to several causes, such as: Insufficient duration of heating; use of dilute solutions and of widely varying ratios of char or carbon to total solids; operating in some cases on the volume basis, and in others on the weight basis.

DEHYDRATION OF ALCOHOL IN THE LABORATORY BY MEANS OF GLYCERIN. *E. Knecht and E. F. Muller. Chemistry and Industry, 1924, 43, No. 6, 143.*

Experiments have been carried out by the authors to ascertain whether the property possessed by glycerin of retaining water tenaciously might be utilized in the dehydration of alcohol in the laboratory. It was found to be so. On mixing 92 per cent. alcohol with glycerin (proportions not stated), and distilling, from a water-bath, pure alcohol came over; while subsequent experiments showed that a very satisfactory yield of pure alcohol may thus be obtained with very little trouble.

COST OF PRODUCING SUGAR AND ALCOHOL IN ARGENTINA. *Anon. Revista Azucarera, 20, No. 250, 284-286;* through *Facts about Sugar, 1924, 18, No. 5.*

In a memorandum submitted by the Centro Azucerara Nacional, on the cost of producing sugar in Argentina, it is pointed out by way of introduction that the figure cannot be determined with great accuracy, because both the yield of cane in the field and the recovery of sugar in the factory vary with the district and the year, while some mills cultivate only part of their cane, purchasing the rest from the farmers, which conditions make the calculation of an average price difficult. However, assuming certain basic prices for labour and materials, and premising 1000 kg. of cane to be worth $12 (Argentine), it is found that the cost of working this amount of cane up to white direct consumption sugar is another $12, making a total of $24, which the provincial tax raises to $26·20.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Louisana State University, Baton Rouge, La.

Dividing this figure by the yield, and then adding the local taxes levied on the sugar manufactured, and other overhead items, the actual cost of 10 kg. of white (unrefined) sugar f.o.b. factory is for different percentages of sugar recovered as follows :—

Yield Per cent.		$ (Argentine) per 10 kg.		Cents (U.S.) per lb.[1]
5·5	....	4·76	....	7·00
6.0	....	4·36	....	6·44
6·5	....	4·03	....	5·94
7·0	....	3·74	....	5·53

As to the cost of manufacturing alcohol in factories from molasses, this varies from 6 to 8 centaves per litre (22·68 to 30·24 centavos per U.S. gall.), according to whether the spirit is rectified or not, which cost figure includes only labour and fuel Assuming the cost of a metric ton of molasses to be $11 (Argentine), the cost of rectified alcohol will be $0·135 per litre, and of unrectified $0 115.

DECOMPOSITION OCCURRING DURING THE DETERMINATION OF THE TRUE SUBSTANCE CONTENT OF BEET MOLASSES BY THE DESICCATION METHOD. *R. G. Gustavson and J. A. Pierce.*[2] *Industrial and Engineering Chemistry, 1924, 16, No. 2, 167-168.*

It has long been recognized that during the determination of the dry substance content (or conversely the water) of molasses, a certain amount of decomposition takes place, thus vitiating the results to a greater or less extent, though neither the nature nor the extent of this decomposition appears to have been ascertained. An attempt has been made to investigate the matter by the authors. Following the conditions prescribed by the A.O.A.C. for the determination of the dry substance by desiccation, that is heating a mixture of beet molasses and sand (1 : 25) to a temperature of about 104° C. for several hours, arrangements were made to collect and examine the volatile matter evolved during this process of drying. Sulphur dioxide, carbon dioxide, ammonia, iodoform-producing substances, and an unidentified oil, were found to distil over under these conditions, and the total percentage of these substances (excluding the oil) that passed off during the time ordinarily necessary for effecting desiccation was 1·97 per cent. If, instead of a temperature of 104°C., one of 90°C. was maintained for several hours at the commencement, the reaction of the fraction was acid, but became alkaline if the temperature reached 104–105°C., which would indicate decomposition at the higher temperature of amido-compounds (possibly aminosuccinamic acid), attention to the presence of which has been called by WILEY and BROWNE.[3] These results, it is believed by the authors, explain (at least in part) the difference existing in the dry substance content as found by the refractometer and by desiccation.

BAGASSE FURNACES USED IN *Gur* FACTORIES. *H. R. Stewart and Kharak Singh. Agricultural Journal of India, 1923, 18, No. 6, 584-595.*

At present the so-called country or local type of furnace, consisting of a circular pit, 6 ft. deep, with a chimney 6–7 ft. high, is the one in most common use in the Punjab; but it has several marked defects, making it wasteful in operation, the fuel used per 100 maunds of juice averaging 70. In comparison with it, the McGlashan furnace,[4] is very efficient, the fuel consumption being only 33 per cent. A modification of the McGlashan, adopted to the requirements of the small cultivator, has a consumption of about 46 per cent. A so-called multiple furnace, one in which the waste heat from the modified McGlashan is made to pass under a second pan, has a consumption of 40 per cent. Then,

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[1] Calculated at 32·5 U.S. cents per paper peso.

[2] University of Denver, Colo., U.S.A.

[3] SHERMAN, "Food Products," 1914 edition ; 421, 427, 431.

[4] *Agricultural Journal of India*, 1920, 15, 520 ; and Bulletin No. 8, of the Department of Agriculture, Central Provinces.

in addition to their modifications of the McGlashan type, the authors have experimented with an improved country or local furnace, and they show that at no very great increase of cost the *gur* manufacturer is able to construct an apparatus burning 53 per cent. of fuel.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR THE YEAR ENDING DECEMBER 31ST, 1923. *F. W. Zerban. New York Sugar Trade Laboratory, Inc., 80, South Street, New York, U.S.A.*

This is Dr. Zerban's first report as Chemist-in-Charge of the New York Sugar Trade Laboratory, and he points out in the introduction to it that Dr. Browne's resignation has been a severe loss to the Laboratory, which under his supervision has developed from small beginnings into a scientific institution of recognized standing known internationally, not only as a testing station, but also for the high character of the research work which has emanated from it. During 1923, the number of samples tested was 16,921; and the average for the entire year was 95·98, the highest in the history of the Laboratory. The variation in average monthly polarizations was only 0·60, again considerably lower than in the year 1922, which had broken the record. The sugars polarizing between 96 and 97 comprised 52·92 per cent. of all samples, whereas during the previous ten years this percentage had varied from 33·63 to 40·31, and averaged only 38·09. The percentage of samples between 95 and 96 polarization was about normal, but that of samples between 90 and 95 showed the low record figure of 9·32. Sugars polarizing less than 90 amounted to only 0·21 per cent. of the total, while the number polarizing above 97 was about normal. It would appear from these results that in general the grade of raw sugars has improved, that they have been drier, and that little deteriorated sugar was received in 1923. One reason for this condition probably was the fact that about one-half of all the sugars were landed between March and June and that little sugar was stored for any length of time. Low grade molasses sugars and mats seem to have practically disappeared.

INTRODUCTION OF MOLASSES INTO THE BATTERY DURING DIFFUSION. *Josep Hamons. Zeitsch. Zucherind. cecho-slov. Republik, 1923, 48, No. 10, 78-79.*

In the year 1885 a process was patented according to which syrups and molasses were purified by introducing them into the diffusion battery, usually one of the intermediate cells, it being claimed that the amount of after-products could thus be diminished. But nothing appears to have come of the idea, although in theory it would appear to have some foundation. According to the writer, a favourable result should be observed when the syrup or molasses is evenly distributed over the surface of the beet slices without being present in excess, under which conditions physical and chemical reactions occur. Inorganic non-sugars present in the molasses (sodium and potassium chlorides and sulphates, etc.) effect the coagulation of certain organic substances in the juice of the slices, while the sulphates and phosphates of the molasses retard the swelling of the mass. In order to test the possible value of such a method of working, experiments were carried out, using a series of glass cylinders, and duplicating as closely as possible the conditions obtaining in the battery in practice; and in these with the addition of 0·5 per cent. of molasses (calculated on the weight of slices used) juices were obtained having a purity 1·3 to 2·0° higher than in parallel tests in which the slices were not previously covered with a solution of the molasses. It would therefore seem that possibly a certain amount of molasses might be worked up in this way in the beet factory. Since the coagulation of certain organic substances in the slices, the adsorption of the molasses colouring matters, and like effects which are believed to take place, are processes of a physical nature, it is clear that one of the conditions of success is the utilization of as large as possible a surface of the slices undergoing treatment. Hence, in adopting the method on a practical scale, the molasses (at say, 40-60° Brix) should be added at the slicing machine, so that it may have every chance of being thoroughly incorporated with the cossettes.

Review of Current Technical Literature.

Theory of the Production of Activated (Decolorizing) Carbon. *N. K. Chaney, A. B. Ray, and A. St. John.*[1] *Industrial and Engineering Chemistry, 1923, 15, No. 12, 1244-1255.*

In a previous paper,[2] the first-named author exposed his theory of the production of activated carbon, in which the terms *alpha* and *beta* were given to the active and inactive forms, and "primary" carbon was defined in a stabilized complex of hydro-carbons adsorbed on active carbon; while further it was pointed out that active carbon results on decomposing at relatively low temperatures (below 500-600° C.), and the inactive variety a higher degrees (usually 600–700° C.). Since the publication of that paper, investigations have been continued, and observations of the physical nature and of the relations of the various forms of carbon have been made. It is now stated that there must exist a definite critical density or porosity of the adsorbent. Contrary to what some other workers have believed, the adsorptive power of any carbon for substances in liquids is directly proportional to its activity as defined by the retentive capacity of the preparation for gases, provided the units of the substances to be adsorbed from solution are small enough, or the porosity of the carbon is great enough, to permit unobstructed access to the active carbon. For removing particles of molecular dimensions from liquids of high mobility, a dense granular gas carbon will be as effective as the finer and more porous forms of equal "activation," but as the size of the adsorbed particles approaches colloidal dimensions increasing dispersion of the carbon is necessary. Some forms of decolorizing carbon owe their effectiveness in adsorbing colloidal particles to their extreme fineness, coupled with relatively low porosity and activity. Others of less minute sub-division rely upon higher porosity of particle, and higher intrinsic activity. It is the latter form that is the superior, not only in filtering qualities, but in a more universal applicability, as they are equally effective for particles of colloidal and molecular dimensions. Viscosity of the liquid is also a determining factor, and a high viscosity requires either an increase in the time of contact or in the degree of dispersion. Technical success in the application of decolorizing carbon can be achieved by the use of special types; for example, some preparations on the market have no prospective value for application to sugar liquors, because of their lack of filtering properties. It is evident that the type of carbon to be selected cannot be considered apart from the development of the appropriate engineering methods for its employment. Mechanical methods for handling boneblack have reached a high degree of efficiency and convenience, and the lack of equally satisfactory methods of handling finely powdered materials is a competitive disadvantage in the case of decolorizing carbons. Ash removal is not a really important factor, because precipitated calcium phosphate is much more effective for removing mineral matter than is the calcium phosphate in the boneblack, just as the best activated carbons are more effective decolorizers than is the carbon in boneblack. There is no reason why ash and colour should be combined in a single operation, if the two can be better performed separately. Summarizing the main points of this important paper, it is shown that mechanical form and structure are as significant as the content of active carbon in determining the industrial applications of carbon preparations; that the required densities of the gas-adsorbent types fall within a relatively narrow range; whereas, in the case of those destined for use in liquids the preferred physical properties may vary from the high densities of the ideal gas adsorbent to the high porosity and sub-division desired of a good decolorizing carbon for the sugar industry; and that the principal reason for this wider range of physical properties required of adsorbents employed in liquids is the enormously wider range in the size of the particles which the latter type is required to adsorb.

Ash Content of Sugar Products, and its Determination. *C. A. Browne and C. A. Gamble. Paper read before the Sugar Division, American Chemical Society, New Haven Meeting, April, 1923.*

A brief abstract of this interesting paper has already been given,[3] but it is now possible to quote more fully what these authors have to say on the important question of the determination of the mineral matter in sugar products, their remarks being as follows: It has long being recognized that the customary deduction of one-tenth from the weight of ash obtained on incineration with concentrated sulphuric acid is only a conventional procedure; not a measure of the true ash content, which may be defined as the sum total of the sulphates, chlorides, nitrates, phosphates, silicates and other inorganic salt constituents *plus* the residue of organic salts after conversion of the latter by incineration to carbonates. The inaccuracy of the conventional sulphate method has led chemists to adopt some methods of direct incineration with a control of temperature and other conditions, so as to prevent losses from intumescence and volatilization of potassium salts.[1] No method of direct incineration, however, can accomplish a complete conversion of molasses or sugar into a colourless ash without a loss of chlorine and sulphur by reduction and volatilization, so that the so-called "true ash" may be considered to be just as conventional as the results by the sulphate method. This may be easily demonstrated by adding a weighed amount of any metallic chloride or sulphate to a quantity of pure sucrose in a platinum dish, and burning away the organic matter under the prescribed conditions until a white residue is obtained. Re-weighing the dish will show an appreciable loss; and a determination of the chlorine or sulphur before and after ignition shows that the loss is due to a volatilization of these elements, the amount varying according to the method of burning and also to the nature of the bases with which these elements are combined. Under the most careful method of burning, consisting in charring the product at the lowest possible temperature, leaching the carbonized matter with hot water to remove soluble salts, adding the ash of the ignited residue to the washings, evaporating to dryness in a platinum dish, and heating to a faint redness, there was obtained a loss of 100 per cent. chlorine with magnesium chloride, a loss of 94 per cent. chlorine with calcium chloride, a loss of 37 per cent. with potassium chloride and a loss of 34 per cent. chlorine with sodum chloride. These results show the absolute inaccuracy of the method of estimating chlorides in sugar products by analysing the ash. This method, which is unfortunately somewhat employed commercially, has probably come about from the statement sometimes made that the quantitative estimation of chlorine as silver chloride should never be made in the presence of organic matter. The fear of loss or contamination, however, is groundless, if the precipitation be carried out in a filtered solution of the product weakly acidified with nitric acid. The loss of chlorine during incineration can be reduced considerably by mixing the sugar product with sodium or potassium carbonate. The same function of retaining volatilized chloride is performed by the natural organic potash salts of low grade sugar products which are converted to the carbonate during incineration, but the action of these compounds, whether added or already present, is never complete. In the case of a low grade molasses, very rich in potash organic salts, there was found by direct precipitation with silver nitrate in presence of nitric acid, 0·88 per cent. chlorine; and by precipitation of the solution of ash after incinerating, 0·78 per cent. chlorine, a loss of about 11 per cent. of the total chlorine. In the case of a raw sugar, which contained much less organic potash salts, there was found by direct precipitation 0·094 per cent chlorine, and by precipitation from the solution of ash 0·018 per cent. chlorine, a loss of about 80 per cent. of the total chlorine. The percentage loss of total chlorine, in determining the so-called true ash, is, therefore, less with low grade products than with high grade products. Similar observations have been made in determining sulphuric acid in sugar products, so that in estimating the composition of the inorganic salts in sugar products it is always necessary to make a correction for the chlorine, sulphuric acid, nitric acid, etc., which are lost by reduction and volatilization. The alkalinity of the ash, which is generally taken as an index of the organic acid content, must also be corrected as the chlorides, sulphates and nitrates of sugar products are more or less converted during incineration into carbonates. Attention must be confined, not to the ash but to the various bases and acids as they are originally present. Ammonium salts, for example, are melassigenic, but none of them is found in the ash. Determinations of ammonia, nitrates, chlorides and sulphates must be made upon the product itself. When this is done, we can re-interpret the results of an ash analysis with a closer approximation to the truth.

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[1] Union Carbide and Carbon Research Laboratories, Inc., of Long Island City, New York.

[2] *I.S.J.*, 1920, 229.

[3] *I.S.J.*, 1923, 436.

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[1] Compare *I.S.J.*, 1923, 329 and 435.

Use of Hydrogen Ion Indicators in Clarification of the Raw Cane Factory.

J. E. Gebelin. La. Planter, 1923, 71, No. 9, 172.

Raw juice from the mills was found by the Clark and Lubs series of indicators to have a pH concentration about 5·0. No inversion (other than the small amount occurring as the result of heat alone) took place when it was limed to pH 6·8, but to be on the safe side the alkalinity was raised to pH 7·2 (cold basis), whereas previously it had been customary to carry it to slight pink to phenolphthalein, that is about pH 10·5. Liming to pH 7·2 was found to be distinctly beneficial, and 30 mins. subsiding was sufficient to give a juice light amber in colour and bright and sparkling in appearance. A yield of 12·98 per cent. of 96° sugar, or 259·6 lbs. per ton of cane was obtained, which result is probably due in the main to the quality of the cane; but the retention was 94·21 per cent. of the sucrose in the raw juice with a final molasses having an average purity of 29·49°, and these results the author believes are undoubtedly due to controlling liming according to the pH value in the manner described.

Steam (Coal) Consumption in Beet Sugar Factories in the U.S.A.

George Rienks. The Sugar Press (Denver, Colo.), September, *1923; through Facts about Sugar, 1923, 17, No. 17, 392-393.*

Tables are given showing the steam consumption per 100 kg. of roots sliced for two factories of the Great Western Sugar Company, in one of which the steam consumption is 64·9 per cent. on roots for a diffusion battery draw-off of 130 per cent., and in the other 71·9 per cent. for a draw-off of 150 per cent. These calculations show that for a factory cutting 1500 tons of roots per day with a draw-off of 130 per cent., 975 tons of steam are required, while a factory operating a 150 per cent. draw-off would require 1080 tons of steam, a difference of 105 tons of steam per day, which means an additional 15 tons of coal per day at the rate of 7 tons of steam per ton of coal. With the latest and most efficient equipment of the G. W. S. Co., slicing 1500 tons of roots per day, an increase or decrease of 20 points in the draw-off increases or decreases the coal required per day by 15 tons (of 2000 lbs.), that is, 1500 lbs. per point, while in certain other factories of the Company one point corresponds to nearly 1 ton of coal (Northern Colorado lignite of 10,000 B.T.U.). As this coal costs about $3 per ton, a decrease in the draw-off of 20 points would amount to $5400 per battery per 90-day campaign.

Tables for the Determination of Sugars (Sucrose, Dextrose, Levulose, etc.)

G. D. Elsdon. Analyst, 1923, 48, 435-443.

Tables showing the quantities of dextrose, levulose, and hydrated lactose, maltose, invert sugar, sucrose, and starch, corresponding with weights of cupric oxide (or cuprous oxide or copper) for each mgrm. from 100 to 460 mgrms. are given, these being chiefly compiled from the data published by Brown, Morris, and Miller.

Pectins of the Sugar Beet.

K. Smoleński. Roez. Chem., 1923, 3, 86-152.

Beet slices contain, in addition to ash and the small amount of remaining sugar, about 30 per cent. of cellulose, and about 60 per cent. of pectins, pentosans, and hemicelluloses. Extraction with dilute mineral acids is the best method of isolating these substances, and the best preparations made were found to be more viscous and adhesive than solutions of gum arabic. A description is given of attempts to determine the constitution of pectin, and a possible constitutional formula is suggested.

J. P. O.

Review of Recent Patents.[1]

UNITED KINGDOM.

STRAINER FOR JUICES OF THE ROTARY DRUM TYPE.[2] *Samuel S. Peck,* of Honolulu, T. H., U.S.A. *208,928.* January 13th, 1923.

Juice strainers have been commonly made of perforated metal having relatively few openings to the sq. in. (about 225 to 400), the holes being circular and of from 0·039 to 0·027 in. in diam. Juice was delivered on top of such a strainer directly from the mill, and the "cush-cush" and suspended matter separated was scraped off by flights, paddles, or slat-like devices drawn over the surface of the strainer by a chain. As the scrapers require a smooth surface over which to operate, perforated metal screens of coarse mesh had to be used, to afford not only proper thickness but also the requisite strength. Woven wire would have been better to use for the screening than perforated metal sheets or plates, due to the smaller mesh obtainable and the greater ease of regulating the size of the mesh, but, because of the constant scraping referred to, it has not been possible to use material of this kind successfully. Another well known for wood pulp, etc., comprises a perforated drum or cylinder arranged to rotate in a tank, the said drum being provided with outwardly extending paddles or baffles adapted to lift the strained solids from the bottom of the tank and throw them over the edge of the tank. It has been proposed to form the paddles of perforated material and to fit brushes or the like to remove the refuse remaining thereon. The present invention relates to apparatus of the rotary drum type; and comprises a foraminous cylinder or drum arranged to revolve in a tank, means for supplying the juice to be strained to the tank, and means for withdrawing the strained juice from the tank and through the cylinder, the latter being provided with screening means arranged to revolve with it so as to carry solids from a low point in the tank to a higher point and one or more freely swinging scraping devices suspended above the screening means and successively engaging the same in order to remove the solids carried thereon. The drum rotates in the tank quite slowly, preferably at about two revolutions per min. The strained liquid may be removed from the drum by two pipes extending into the drum one of which has a downward extension to enable the liquid to be pumped or syphoned out, and the other of which has an upwardly projecting, funnel-like portion adapted to catch any juice, which, delivered to the top of the drum above the said portion, falls clean through the drum. The juice which flows down exteriorly of the drum, or through it but beyond the reach of the funnel-like portion, collects in the bottom and is removed by the first mentioned pipe. Alternatively, the strained liquid may be removed in well-known manner through an outlet disposed centrally of one of the ends of the drum. The drum is used primarily for filtering and straining, and the only scraping

FIG.3.

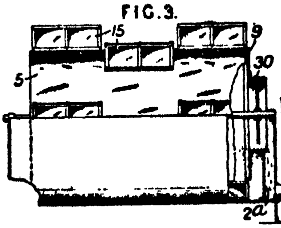


FIG.2.

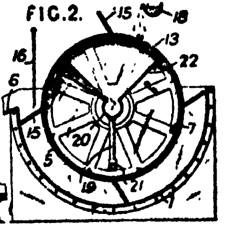
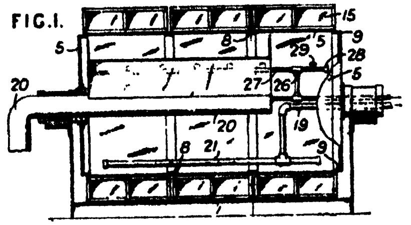


FIG.1.



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

[2] See also *I.S.J.*, 1921, 91, 155; 1922, 31; 1923, 432, 466.

action is that to which the paddles carried by the drum are subjected in order to have the solid matter removed from them. In other words, the scrapers do not operate directly on the filtering device (drum) and hence the drum may be made of wire gauze as fine as 100 mesh, or even finer. This enables the removal of a far greater proportion of "cush-cush," etc , than is possible with the screening devices heretofore proposed.

Turning to the drawings describing the apparatus, it is seen that it comprises a revoluble foraminous drum *5* to which outwardly-extending strainers or paddles *15* are attached, which lift solid matter from the lower part of the containing tank *1* to a swinging scraper *16*, which pushes it on to a chute *6*. The drum may be formed of longitudinal angle irons *7*, hoops *8*, flanged end members *9* and two layers of gauze held in place by straps *13*. The liquid to be filtered is delivered on top of the drum from a trough *18*, and that which passes through the upper portion of the drum is caught by a funnel-like extension *22* of a pipe *20* which passes outward through one of the trunnions. Liquid entering the lower portion of the drum is withdrawn siphonically or by a pump through a perforated pipe *21* and a pipe *19*. Matter adhering to the drum is blown off by steam or air discharged through nozzles *28*, *29* on a pipe *27*, the fluid being supplied through a pipe *26* which enters through the trunnion. Fig. 3 shows a staggered arrangement of the paddles *15*, and modified means for the discharge of the filtered liquid, which flows away through a collar *30*, attached to one of the end frames *9* and engaging tightly in a cutaway portion of the wall *2a* of the tank.

PRODUCTION OR REGENERATION OF ACTIVE (DECOLORIZING) CARBON. ***General Norit Co., Ltd.***, of 2, Den Texstraat, Amsterdam, Holland (Assignees of ***J. N. A. Sauer***). *206,862*. January 13th, 1923; convention date, May 26th, 1922.

A process for producing uniformly active charcoal, or for regenerating spent charcoal, of the type in which a carbonaceous material is distilled in presence of active gases, is characterized in that raw material, which may be the less porous kinds of coal and carbonaceous materials such as brown coal, anthracite, and coke produced by the low temperature carbonization of peat, etc., is first pulverized or granulated preferably uniformly and then subjected to the action of heat and activating gases while being maintained in a state of agitation or suspension in a body of gas by a blast of gas. The raw material may be preliminarily carbonized, the products of distillation being quickly swept away, e.g., by the passage of practically inert gases. Activating gases specified are steam (preferably superheated), carbon dioxide, air, oxygen, hot burning gases, carbon monoxide, hydrogen, generator gases and oxidizing gases. In the case of regenerating spent charcoal there is preferably used a substantially inert gas mixed with a small proportion of an oxidizing gas, for example carbon dioxide, steam, oxygen or chlorine, such that the oxidation is substantially limited to the secondary carbon deposited in the pores as a result of the distillation. The vertical retort described in Specification 189,148 is referred to as a suitable apparatus for carrying out the process.[1] In an example the process is applied to charcoal granules of 2–4 mm. diameter, the heating of the retort being internal, external, or both. A series of retorts or of zones may be employed in which there are introduced different activating gases, and in which are maintained different temperatures.

CONFECTIONERY. (1) ***Baker, Sons, & Perkins, Ltd., G. R. Baker, and R. Head***, of Willesden, London. *204,252*. December 23rd, 1922. (2) ***A. Sonsthagen***, of Highstone, Leytonstone, London. *207,415*. January 10th, 1923. (3) ***W. Boyd*** and ***W. H. Yates***, both of Broughty Ferry, West Forfarshire. *207,974*. November 10th, 1922. (4) ***Package Machinery Co.***, of Springfield, Mass., (U.S.A.). *208,153*. December 5th, 1923; convention date, December 7th, 1922. (5) ***A. Sonsthagen***, of Highstone, Leytonstone, London. *208,846*. October 17th, 1922.

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[1] *I.S.J.*, 1923, 166.

SETTLING TANKS FOR USE IN THE CLARIFICATION OF JUICE. *Cuthbert G. Petree*, of Munson Building, New York City, U.S.A. *208,094.* July 5th, 1923.

This invention relates more particularly to that type of apparatus comprising an inverted cone-shaped settling vessel provided with a central cylindrical feed throat extending a short distance beneath the surface of the liquid undergoing treatment; a volute wall or baffle plate, also extending a short distance beneath the surface of the liquid and from the outer wall of the feed throat to the inner wall of the settling vessel so as to form a volute path of increasing width; scrapers, adapted to be rotated slowly in contact with, or in close proximity to the inner conical surface of the settling vessel to remove any of the precipitate that may have settled there; an overflow, at the periphery of the settling vessel for the clarified liquid, and an outlet, at the apex of cone at the bottom of the vessel for the removal of the precipitate. The central feed throat of apparatus of this kind (as heretofore constructed) has been provided with an opening at or near the surface of the liquid in the settling vessel through which the fresh liquid to be treated passes to the volute path carrying with it the lighter impurities and scum that remained on the surface which were removed by an inverted weir or intercepting plate placed obliquely across the volute path, beneath which the clear liquor could pass, but along the inclined surface of which the floating impurities were carried to the scum outlet. In order to preclude the possibility of floating impurities of a flocculent character passing out with the clear liquor, the opening in the feed throat at or near the surface of the liquid is closed, and the lower edge of the feed throat or a part of it near the point where the volute path starts is removed so that the liquor fed into the throat will pass into the volute path through the opening so made, which is sufficiently above the lower edge of the volute walls to insure that the fresh hot liquor passing through it will, by reason of its lower density, rise into the first convolution of the volute path. With this arrangement the floating impurities are trapped within the throat, whence they are eventually precipitated when the bubbles that buoy them up have been dispersed, or the impurities may be otherwise removed by mechanical or other suitable well known means. By the present improvements the peripheral scum outlet is dispensed with, and greater space made available for a longer clear liquor overflow, which may be constituted by the inner lip of a channel-formed at the periphery of the settling vessel by bolting or otherwise securing a species of gutter thereto. This gutter may be formed in sections each of which delivers clear liquor into a separate draw-off pipe, or it may be formed in one piece and extend either partially or completely around the settling vessel. In order that impurities deposited on the walls on the settling vessel near the surface of the liquid undergoing treatment may be removed, a sufficient space is left between the outer end of the volute wall and the wall of the settling vessel for the scrapers to pass through for the purpose of removing such deposit to the bottom of the vessel. For this purpose the upper portion of the volute wall is connected to the settling vessel and the portion beneath is either cut away or splayed inwardly.

FIG. 1.

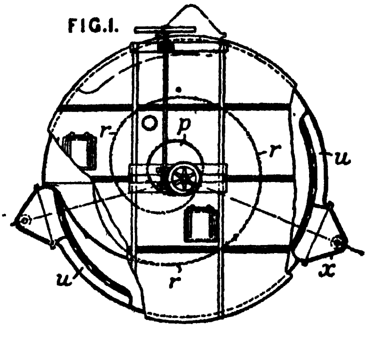
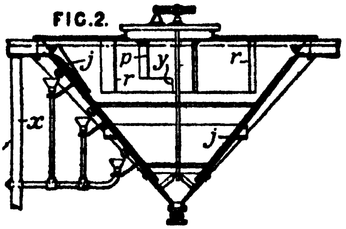


FIG. 2.



According to the construction shown in the drawings, a settling-tank is fitted with a central feed throat *p*; a volute wall *r* extending from the throat to the outer wall of the outer wall of the tank; revolving scrapers *j* to remove matter from the conical wall of the tank; an overflow round the edge of the tank; and a central outlet at the base. The throat has an opening or cut-away portion y near its lower edge, through which the liquid delivered to the tank passes into the channel formed by the volute walls and the outer edge of the volute wall, while connected to the wall of the tank at its upper extremity, is cut away or splayed inwardly so as to leave room at this position for the passage of the scrapers. The overflow u is shown as formed in sections each having its own discharge pipe x.

Filter Presses. *Gavin A. Renton*, of Ravenscourt Park, London. *208,253.* September 21st, 1922.

Filter-presses are made with collapsable chambers between adjacent filter-plates, so that the cakes formed may be subjected to pressure.

HOLLAND.

Mill Roller Provided with Protruding Teeth or Studs. *Gerrit van den Berg*, of Soerabaja, Java. *6834.* January 28th, 1922.

Many devices have been proposed for the purpose of improving the gripping power of the mill roller; for example, studs or blades let into the surface of the roller, but not projecting therefrom; cast teeth projecting from the surface; or pins projecting from the surface, but capable of being pressed back against a spring. Such devices are said to be disadvantageous, soon leading to slipping, or exerting an insufficient gripping power. According to this invention, a roller is provided with teeth or studs dispersed over it, these elements being let into the surface and being immovable, but protruding therefrom. It is evident that the teeth or studs must not protude so far that they are capable of affecting the precise setting of the roller opposite; seeing that they are forced into the cane where it is most strongly pressed between the rollers, it is clear that they exert a great effect in preventing slipping. Since they are so fixed as to be immovable, this means that no juice can penetrate under them, and thus affect the permanency of their setting; while since they are dispersed over the surface means that gripping can take place without bumping being caused. Turning to the sketches, Fig. 1 represents the complete mill roller; while Figs. 2, 3 and 4 show different views of the teeth. In the two last figures, a portion of the shell of the rollers is shown in section with a steel tooth a fixed therein. The portion of the tooth projecting from the surface of the roller is angular to facilitate its pressing into the cane.

FIG. 1

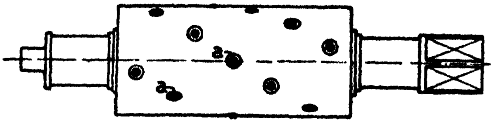


FIG. 2

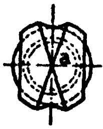


FIG 3

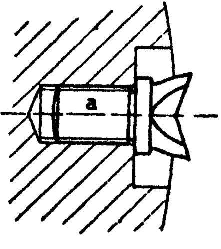
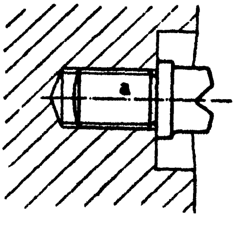


FIG. 4



UNITED STATES.

Cane Loading Apparatus. *Joseph Fritschi and William P. Hughes,* of Honolulu, T.H., U.S.A. *1,474,685.* November 20th, 1923. (Three figures; ten claims.)

This invention[1] relates to conveyors for loading cane directly from the field. While in operation, the bulk of the weight of the apparatus rests on track sections carried by the car being loaded, the outer end of it resting as close to the ground as possible. As will be seen from the drawings here reproduced, the apparatus comprises a pair of oppositely disposed inclined frame members, which consist of a series of parallel inclined rods *1*, having their upper ends connected by a transverse tube *2*, and their lower ends secured to a transversely disposed plate *3*, which during loading rests on the ground or the plate may be supplied with a light framework comprising legs *4*. The upper end of the inclined member is supported on vertically disposed standards *5*, whose lower ends are connected to the lower ends of the outside inclined rods *1* of the frame member by a substantially horizontal brace *6*, and an intermediate substantially vertical brace *7* may be applied. The extreme lower end of each vertically disposed standard *5* is supplied with a flanged wheel or roller *8* engaging a truck *9* secured to each side of a loading car *10*, whereby the inner end of the inclined frame member is movably supported. Moving over the face of each of the inclined frame members is a conveying means comprising a series of endless wire cables

Fig. 1.

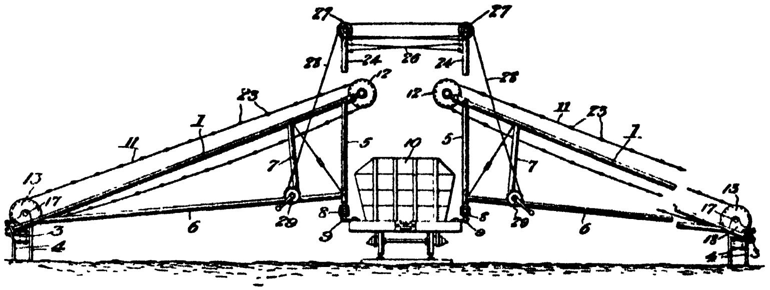
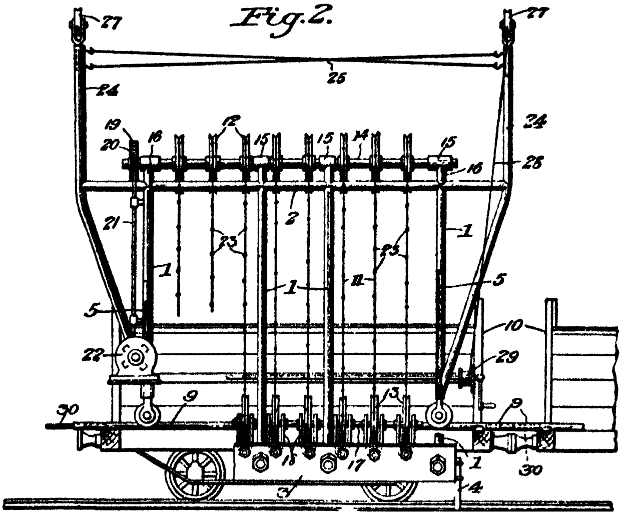


Fig. 2.



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[1] For some remarks on the Fritschi-Hughes loader see *I.S.J.*, 1923, 648.

or chains *11* supported upon sheaves or sprockets *12* and *13*. The sheaves *12*, mounted at the elevated end of the conveyor frame, are supported upon a shaft *14* properly journaled in bearings *15* carried by extensions *16* of the inclined tubes *1*. The lower sheaves *13* are mounted upon a shaft *17* secured in proper position by brackets *18* attached to the plate or cross beam *3*. The sheaves *13* are freely rotatable upon their shaft *17* or may be secured to said shaft, which is freely rotatable in its supporting brackets *18*. Sheaves *12* are keyed to their supporting shaft *14*, one end of said shaft being supplied with a gear *19* meshing with a worm *20* mounted upon a shaft *21* operated by a motor *22*, whereby the shaft *14* will be rotated, which operation will in turn rotate its supported sheaves *12*, carrying with them the conveyor cables *11*, the sheaves *13* merely idlying upon their supporting shaft *17* in an obvious manner. In order to provide a gripping action between the conveyor cables and cane, the conveyor cables *11* are provided with knots or projections *23* arranged at certain intervals throughout the length of each conveyor cable. In this connexion it is to be understood that light detachable chains running on sprockets can be used instead of wire rope, certain links of said chain having attached thereto projections to prevent slipping, in a manner similar to that just described. Extending upwardly from each vertical standard *5* is an upright *24* projecting above the elevated end of the conveyor, and the upper ends of the uprights of each conveyor section are connected by stay wires or the like *25*. The upper ends of the oppositely disposed uprights of the two conveyor sections are likewise connected together by stay wires *26*, whereby the lower position of the outer lower ends of said conveyor sections may be properly regulated. The extreme upper ends of the uprights *24* are supplied with sheaves *27* adapted to co-operate with cables *28* running around winding drums *29*, whereby the uprights *24* may be drawn together when it is desired to elevate the lower outer ends of the conveyor sections during the moving of said conveyor sections from one loading position to another. To permit the conveyors to be moved along the tracks *9* from a loaded car to the next car to be loaded, it is necessary that said trucks be continuous, necessitating a means of joining the abutting ends of the track sections carried by each individual car. This has been accomplished by constructing the track sections *9* of pipe and securing their ends together by telescoping joint involving the use of a pin or the like *30*, as clearly shown in Fig. 2. Operation of the apparatus will be perfectly obvious. When a car is loaded, and it is desired to move the conveyors, the lower ends thereof are elevated upon the operation of the winding drums *29* co-operating with their respective cables *28*, whereby the upper ends of the uprights *24* will be drawn together, the conveyor frames swinging upon their supporting rails as a centre. The outer ends are thereby lifted from the ground, and the whole weight thereof taken on the portable rails carrried by the loading cars. The conveyors are then pushed by hand, or pulled by any preferred mechanical means, to a new position adjacent the empty car to be loaded. If preferred, the flanged rollers *8* supporting the elevated ends of the conveyors may be provided with roller or ball bearings so that they will move with the least possible friction. With the above construction a whole train of cars may be quickly and successfully loaded in a very simple and effective manner, requiring only the minimum amount of manual labour.

BEET HARVESTERS. *Samuel C. Beale*, of Los Angeles, Cal., U.S.A. *1,476,946*. December 11th, 1923. BEET LIFTERS. *John M. Henton*, of Hot Springs, S. Dak., U.S.A. *1,477,561*. December 18th, 1923.

USE OF KIESELGUHR FOR FILTRATION. *Harry S. Thatcher* (assignor to *The Celite Co.*, of Los Angeles, Cal., U.S.A.). *1,477,394*. December 11th, 1924.

Claim is made for the method of producing a material adapted for use as a filter-aid, consisting in heating finely-divided fresh diatomaceous earth (kieselguhr) to a "sufficiently high temperature" to increase its effectiveness as a filter-aid and adsorptive agent.

Sugar Crops of the World.

(Willett & Gray's Estimates to February 31st, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
United States—Louisiana	Oct.-Jan.	150,000	263,478	289,669
Texas	,, ,,	2,500	2,875	2,920
Porto Rico	Jan.-June	350,000	338,456	362,442
Hawaiian Islands	Nov.-July	540,000	479,463	502,194
West Indies—Virgin Islands	Jan.-June	2,000	1,739	5,000
Cuba	Dec.-June	3,750,285	3,602,910	3,996,387
British West Indies—Trinidad	Jan -June	55,000	41,619	59,948
Barbados	,, ,,	50,000	52,715	36,742
Jamaica	,, ,,	33,000	33,029	42,167
Antigua	Feb.-July	10,000	12,642	9,850
St. Kitts	Feb.-Aug.	10,000	10,735	8,426
Other British West Indies	Jan.-June	8,000	8,142	9,238
French West Indies—Martinique	Jan.-July	17,000	19,700	18,329
Guadeloupe	,, ,,	26,000	30,000	32,000
San Domingo	Jan.-June	200,000	184,171	225,000
Haiti	Dec.-June	10,000	10,000	12,283
Mexico	,, ,,	135,000	130,763	119,800
Central America—Guatemala	Jan.-June	22,000	24,445	19,090
Other Central America	,, ,,	37,000	28,000	27,972
South America—				
Demerara	Oct.-Dec. and May-June	90,000	101,128	107,797
Surinam	Oct. Jan.	10,000	11,000	10,000
Venezuela	Oct.-June	18,500	16,000	16,000
Ecuador	Oct.-Feb.	17,000	14,220	13,318
Peru	Jan.-Dec.	325,000	313,743	319,864
Argentina	May-Nov.	250,000	209,718	172,236
Brazil	Oct.-Feb.	628,000	595,723	491,933
Total in America		6,746,285	6,636,414	6,910,605
Asia—British India	Dec.-May	3,240,000	3,011,000	2,532,500
Java	May-Nov.	1,756,402	1,746,875	1,649,610
Formosa and Japan	Nov.-June	450,000	405,800	406,966
Philippine Islands	,, ,,	323,000	264,000	338,160
Total in Asia		5,769,402	5,427,675	4,927,236
Australia	June-Nov.	279,700	306,678	299,465
Fiji Islands	,, ,,	35,000	40,000	71,731
Total in Australia and Polynesia		314,700	346,678	371,196
Africa—Egypt	Jan.-June	100,000	94,554	108,963
Mauritius	Aug.-Jan.	200,000	231,190	197,420
Réunion	,, ,,	50,000	40,000	55,564
Natal	May-Oct.	108,463	158,221	155,194
Mozambique	,, ,,	60,000	45,950	34,446
Total in Africa		590,463	569,915	551,587
Europe—Spain	Dec.-June	12,000	13,918	13,805
Total cane sugar crops		13,432,850	12,894,600	12,774,429
Europe—Beet sugar crops		4,986,400	4,516,289	3,973,100
United States—Beet sugar crop	July-Jan.	775,000	615,936	911,190
Canada—Beet sugar crop	Oct.-Dec.	14,500	12,400	18,931
Total beet sugar crops		5,775,940	5,144,625	4,903,221
Grand total Cane and Beet Sugar	Tons	**19,208,790**	**18,039,225**	**17,677,650**
Estimated increase in the world's production	,,	1,169,565	361,575	914,658

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to February 20th	382,967	..	424,224
Deliveries ,, ,, ...	383,861	..	424,224
Meltings by Refiners ,, ,, ...	339,280	..	387,870
Exports of Refined ,, ,, ...	3,500	..	13,000
Importers' Stocks, Febuary 20th	—	..	—
Total Stocks, Febuary 20th	69,290	..	54,163
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1920-1921, 1921-1922, AND 1922-1923.

(Tons of 2,240 lbs.)	1921-22. Tons.		1922-23. Tons		1923-24. Tons.
Exports	70,932	..	387,680	..	367,227
Stocks	116,785	..	274,135	..	240,622
	187,717		661,815		607,849
Local Consumption	5,000	..	5,000	..	5,000
Receipts at Port to January 31st	192,717		666,815		612,849

Havana, January 31st, 1924. J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to February 20th, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
Germany	Sept.-Jan.	1,125,000	1,463,000	1,305,810
Czecho-Slovakia	Sept.-Jan.	1,030,000	733,825	659,907
Austria	Sept.-Jan.	40,000	23,976	16,322
Hungary	Sept.-Jan.	125,000	81,603	74,898
France	Sept.-Jan.	495,000	490,360	306,073
Belgium	Sept.-Jan.	300,000	268,928	289,866
Holland	Sept.-Jan.	230,000	255,592	379,770
Russia (Ukraine, etc.)	Sept.-Jan.	300,000	193,400	49,374
Poland	Sept.-Jan.	378,600	294,269	179,096
Sweden	Sept.-Jan.	153,890	71,790	231,066
Denmark	Sept.-Jan.	114,000	88,382	146,800
Italy	Sept.-Jan.	311,450	261,607	217,532
Spain	Sept.-Jan.	190,000	160,035	72,257
Switzerland	Sept.-Jan.	5,500	8,000	5,856
Bulgaria	Sept.-Jan.	40,000	16,250	12,712
Roumania	Sept.-Jan.	80,000	49,872	25,761
Other Countries	Sept.-Jan.	68,000	55,400	—
Total in Europe		4,986,440	4,516,289	3,973,100

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th February, 1924.

The market as a whole continued to advance until the 13th inst., when a reaction set in, since which date the market has experienced various fluctuations but prices for actual sugar have been fairly well maintained although a dull tone has prevailed.

The terminal market continued its advance and there were obvious signs of speculation taking a keener interest in the market. 3000 tons were tendered in February, and about 8000 tons have already been tendered on March but the sugar is readily taken up and continues to make no impression on prices. The advance was checked by the reduction bv the British Government of the reparation tax on imported German goods from 26 per cent. to 5 per cent. and the idea that German sugar would come to this market caused holders to lose confidence. Covering orders continued to reach the market from the Continent for the nearer deliveries. February sold during the month from 34s. up to 35s., March from 34s. to 35s. down to 33s. 6d. to 34s., May from 33s. 3d. to 34s. 10½d. to 33s. to 34s. 4½d. to 31s. 6d. to 33s. to 31s. 9d., August from 31s. to 32s. to 29s. 1½d. to 30s. 10½d. to 29s. 9d. A good business has continued in new crop and October/December has been sold from 26s. 3d. to 26s. 7½d. to 24s. 7½d., whilst November and December sold from 25s. 4½d. to 26s. 1½d. to 24s. 1½d.

Trading in actual sugar continued brisk both for spot and forward until the re-action in the market set in. The traders in this country who have continued to adopt a hand to mouth policy have remained out of the market for the last three weeks owing to the fear of German exports and to the nearness of the budget A fair business, however, has been done in forward months as far as June. The London refiners have advanced their prices to 1s. 6d. per cwt., and to-day's quotations are No. 1 cubes 67s., London granulated 64s. 1½d.

The refiners were constant buyers of raws during the first week of the period under review and have made large purchases of Cubans from 28s. 9d. up to 30s. 6d. down to 28s. 9d., and the latest business was 29s. 1½d. Continental countries have also bought Cubans at varying prices during this period. Foreign refined have not been very active, and only a moderate business has been done. Navigation on the Elbe continues closed, the only business therefore done in Czecho Granulated was for the re-opening of navigation and for April, May, and June deliveries.

A moderate business has been done from 33s. up to 34s. 6d. down to 33s. 6d., and the latest prices are 33s. 3d. for re-opening and for 33s. 6d. for April/June. Dutch Granulated has been in constant demand and sold from 33s. 9d. up to 35s., and the last business was done at 34s. 6d. The export of Granulated from Belgium was for a time prohibited by the Belgium Government, but since this order has been rescinded. A small business was done in May/June Javas from 29s. 6d.—28s. 6d., and June/July 28s. 6d.—27s. 6d. c.i.f. Spot Javas have been sold from 59s. 9d. to 61s., and fine granulated on the spot, which is very scarce sold from 61s. to 62s. American Granulated was well above the parity of this market, and a few isolated parcels were offered from 36s. to 35s. 6d.

The demand for refined in America has not been very brisk and the trade continues to buy from hand to mouth. The refiners who are not carrying large stocks are forced to come into the market every week to make fresh purchases and a large quantity of Cubans have been marketed at round about 5½ cents the latest transactions took place at 5⅝ cents.

No further news has been received regarding the Cuban and European crops. Messrs. GUMA & HIMELY maintain their estimates for the Cuban crop of 3,800,000 but other competent experts in the island consider the crop will not be larger than last year. There is every indication that the sowings for the 1924-1925 European crop are likely to be increased by an average of something like 20 per cent., but owing to the severe winter there is a delay already of about three weeks in preparing the beet fields.

21, Mincing Lane,
London, E.C. 3.
12th March, 1924.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE
INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 304. APRIL, 1924. Vol. XXVI.

Notes and Comments.

Pan-Pacific Food Conference at Honolulu.

The Pan-Pacific Union (an organization representing all the Pacific races) is about to hold at Honolulu, during the first fortnight of August next, a Food Conservation Conference, at which representative delegates from all the important Pacific communities will confer on the scientific phases of food production. Steps are being taken to organize a cane sugar section, and in so doing the promoters are extending the field beyond the immediate Pacific area and are attempting to include all parts of the world. This scheme, if successful, would bring about what it is hoped would prove the first world convention of cane sugar investigators, providing of course that the invitations which are being broadcasted to representative sugar men all over the world to come to this gathering can be accepted by an appreciable percentage of those so addressed. Honolulu would not ordinarily prove an ideal centre for a world convention, being rather out of the way of the majority of the world's scientific workers; but the sugar industry is world-wide, and the borders of the Pacific Ocean, including as they do such sugar lands as Japan, Java, Queensland, Peru, and California, while Hawaii rests in the midst, undoubtedly enclose a very appreciable section of the world's sugar industry. So it is probably the case that Honolulu is as good a venue as any that could be suggested, if it is desired to hold the conference in a centre where not only can theory be discussed but practice can be conveniently studied. This and the superb climatological conditions in evidence, both at their destination and on the way to and from it, must have attractions to the visitors concerned that would not be encountered were the Conference held in one of the world's big cities and travelling centres.

It is to be hoped then that the sugar technologists of Honolulu, with Mr. H. P. AGEE at their head, who are organizing this cane sugar section of the conference, will not be disappointed at the response to their invitations, even though we fear the time available for making arrangements for the trip is not so long as might have been desirable. A comprehensive list of subjects for discussion has been tentatively drawn up (which will be found on another page) and this, we are glad to note, devotes just that very considerable proportion of items to the *cultivation* side as we are accustomed to expect from the Hawaiian sugar experts. This is all to the good, inasmuch as it is in respect to cultivation rather than in respect of sugar manufacture that modern practice is prone to be backward, if not negligent; and an opportunity to discuss the subject at length under Hawaiian auspices, which, we assume, will include an opportunity to inspect Hawaiian practice on the spot, is a chance that should not be missed by those who have a say in the ordering of cultivation procedure in other sugar regions of the world.

As will be seen the agenda, in six out of seven of the sections, deals with plantation matters. It is difficult to find anything left out, but possibly some of the members or visitors might feel inclined to deal with the vexed question of labour, and a comprehensive survey of this aspect of sugar cane cultivation the world over is much needed. Closely connected is the subject of power implements, but both of these could easily be introduced under "cultivation" in its wider significance. There is no mention of the physiology of the sugar cane plant, but comparatively few workers excepting in Java have devoted much time or attention to this important subject. Connecting it with the section on water resources, the duty of water transpiration losses in different climates and conditions might be dealt with if anyone feels that he has the requisite knowledge. Very little accurate work has as yet been done on this important part of irrigation in many countries habitually employing it. On the whole, however, the agenda covers the field very completely, and the work sketched out is quite enough for any one meeting.

Home Affairs.

The Budget is due in Parliament at the end of this month, and we shall soon know what ideas our first Labour Government has with regard to the present incidence of sugar taxation in this country. There are, as is known, three aspects of it. First, the general revenue accruing to the Treasury, which is not far from twenty millions sterling per annum and cannot lightly be dropped by a Government which is not putting economy in the forefront of its general policy; second, an appreciable reduction in the amount of the duty as far as British overseas sugars are concerned; and, thirdly, the total remission of the duty in the case of home-grown sugars, which is a concession to their experimental nature.

Speculation is of course rife as to what will be done. The well-known desire of the Labour Party for a free breakfast table will encourage at least the partial reduction of the present admittedly excessive—from the consumer's point of view, that is—duty of 2¾d. per lb. The Prime Minister is known from his utterances to be favourable to British agriculturists being helped further in their new experiment of cultivating sugar beets and including this crop in their customary rotations. As for the British Colonial sugar industry, it knows from bitter past experience that it is prone to be made the victim of home politics—to be sacrificed on the altar of Free Trade. But the Government has no clear course to steer; it is at the mercy of two other parties, any combination of which would result in the rejection of Government measures. It is also this year under the economic necessity of carrying on finance much as it was left by the late Government. For these reasons we do not anticipate any *volte face* on the part of the Chancellor of the Exchequer. He is more likely to steer a non-controversial course and avoid reverses in the House of Commons. The Government and the Prime Minister have lately received numerous representations from interested societies and parties, urging the continuation of the existing fiscal system as far as sugar is concerned, and they cannot be oblivious of the fact that recent history has been pointing to the inadvisability of our sugar supplies being too much in the hands of American and Cuban interests. However, another fortnight should show us what impression these appeals have had on the drafting of the 1924 Budget.

New British Beet Ventures.

Yet another company has lately been formed for the purpose of beet sugar manufacture in this country. The "Anglo-Scottish Beet Sugar Corporation Ltd.," was registered as a private company at the end of January with a nominal capital of £50,000 in £1 shares "to carry on the business of manufacturers and refiners of and dealers in all kinds of sugar and sugar products." The first Directors include Mr. J. B. TALBOT-CROSBIE (of Messrs. Duncan Stewart & Co., Ltd., Glasgow), LORD WEIR of Eastwood, LORD INVERNAIRN (formerly Sir William Beardmore), SIR ERNEST JARDINE, Bart. A factory is to be erected this year at Colwick, Nottinghamshire, and the promoters hope to make arrangements to encourage growers of beetroots not only in the immediate vicinity of this factory, but also in the surrounding districts of Worcestershire, Staffordshire, Warwickshire and south Shropshire. This company have also, it is reported, the intention to set up a factory in Scotland once farmers there can be convinced of the profitableness of beet cultivation and a sufficient supply of roots can be assured.

Other moves in this direction include the making of enquiries by an American Syndicate in the Eastern Counties with regard to the purchase of from 20,000 to 30,000 acres of land for sugar beet cultivation. It is proposed to make a start with a tract of not less than 5000 acres and to erect a beet factory, which in this instance would presumably be of American design if not in part of American manufacture. But American engineers for reasons of cost are understood to be willing to combine American design with the more adjacent British manufacture of the plant in any pioneer beet sugar factories they are responsible for erecting in this country.

For ourselves we can only repeat what we have said on a previous occasion that it seems very desirable that while beet sugar manufacture in this country is in an experimental stage, the pioneer factories concerned should represent, so to say, as many "schools of thought" as possible. In other words, no one foreign country's standard ideas of beet sugar production should prevail to the exclusion of a trial of the others. Cantley was started under Dutch auspices and to that extent can be assumed to represent Dutch practice. Kelham was conceived and erected in a French atmosphere. It is greatly to be desired that American ideas of design and factory procedure should be available in another factory. Undoubtedly but for the Great War, we might ere now have had a factory also of German conception, which in view of the high position the German beet sugar industry has always held in the world's work would have been a useful adjunct to the experiments. The main thing is to make as complete an experiment as possible into the chances of *establishing* a beet sugar industry in this country either under a certain degree of protection or else free of it; and for that purpose we should (to quote that much used cliché of post war diplomacy) "explore every avenue possible" to obtain the means and methods most likely to achieve our purpose.

Progress of the Cuban Crop.

Our Havana Correspondent writes that as the Cuban sugar crop has just approached its half-way post, it is convenient to take stock of how the crop is progressing. The deliveries to the seaports down to March 15th amounted to 1,826,000 long tons, as compared with 1,803,000 tons last year and 1,302,000 tons in 1922. Thus they are greater than in the two previous seasons and indicate that the present crop should be a little larger than that of last year. The weather is very favourable for harvesting and manufacturing, and providing it continues so, a big advance will be made in crop operations during the period between March 15th and the middle of May. Very heavy deliveries will reach the ports, and there will be a large amount of sugar awaiting shipment as the market offers.

The sugar content of the cane is reported to be higher this year than it was last, all provinces save one reporting a richer cane juice; and this fact has to be taken into consideration in arriving at any estimate of the sugar crop now in progress. On the average, to date, there is an increase of 0·42 per cent. sucrose in the cane, and on a crop of 35 million tons of cane the increase amounts to quite a large quantity of sugar. In fact, if the tonnage of cane harvested this year attains to last year's quantity, the extra sucrose in the cane will mean an extra production of over 100,000 tons.

Basing one's estimate of the present crop on the progress made to date, on the improved sugar content, and on the good work the factories are doing, the indications are that the eventual output for 1923-24 will exceed last year's figures by a small margin. The latter amounted to 3,600,000 tons, while this year's crop gives promise of running to as much as a hundred thousand tons more, or to 3,700,000 tons.

Beneficial Aspects of Misfortunes: Their Precise Importance.

In our present issue we publish a characteristic contribution from Mr. A. H. ROSENFELD containing some of his first impressions on taking up his post as Special Technologist for Cane in Porto Rico; and, although we are in no sense responsible for the opinions of our contributors, there is to our mind a sufficient substratum of truth in what he says to interest our readers. He effects to consider the recent outbreak of mosaic disease in the island as on the whole beneficial; but we fear his treatment of the subject is in a sense somewhat brutal, and smacks a bit too much of the now discredited proverb "spare the rod and spoil the child." In these modern days we generally try to give due value to all sides of a question; we pay some attention, perhaps more than we ought to, to the child's view-point, and it is a matter of doubt whether the relations between parent and child have been improved thereby. But it strikes us as misleading and unfair to ignore all the loss and failure caused by an economic disaster when, as is occasionally the case, the elasticity and persistence of human endeavour rebuilds an industry from its ruins and, naturally, builds it on securer lines. In this sense our contributor's article must be deemed one-sided and disappointing; it is, so to speak, more journalistic than scientific, though none the less readable for that. To take the boll weevil example (and all of the examples could be treated in the same way), it is true that as the result of strenuous propaganda mixed farming has been established in certain localities in the United States cotton belt, and with great advantage to those who have had the capital and energy to make the change. But what about the vast areas gone out of cultivation, which have given this tract such a desolate appearance as to frighten away prospective settlers from the north? It would hardly be expected, moreover, that such an enthusiastic view would be taken of the boll weevil in Lancashire, still the centre of the world's cotton trade, for its influence is seen in half the mills being in difficulties if not closing down altogether; so in India and Africa, where many people must perforce go more or less without the modicum of clothing which we have managed to provide them with. And, in the cotton belt itself, what would happen if an end came to the present high price of the raw staple? For it is no secret that the margin of profit is a very small one, and even now the area seems to be steadily decreasing. With the conditions of the cane industry in Porto Rico we cannot of course pretend to be so well informed as Mr. ROSENFELD, and we are glad to note his optimistic vein regarding it; but all the same we do not think that the introduction of such cane varieties as the Kavangire or Uba is to be desired in a rich tropical country, which should be capable of cultivating the best products of recent scientific research, and the selective work of many generations. Personally, we consider such a change on the whole retrograde, and not less so because, inevitably, it will bring in its train more careless and slovenly cultivation, as it has done in Natal. These canes have their uses, for instance as a temporary expedient against mosaic, or for growing on lands not good enough for the better class canes ; but we should be sorry to see their great extension in this magnificent island or, indeed, anywhere else in the tropics. We think it right to put this view of the matter before our readers ; for it is almost permissible to suspect that it has been purposely kept in the background by our contributor, so as to emphasize the point of view which he has presented with such force and ability.

Apart from this question of varieties grown, there is by all accounts much work to be done in the improvement of plantation practice in Porto Rico, and we are glad to note that Mr. ROSENFELD considers that matters are mending in this respect. Any such improvement must be largely due to the whole-hearted services of the members of the staff of the Agricultural Department, although in the past ordinary cultivation practices have not received so much attention *per se*, as they have done as accessories in the fight against pests and diseases. We trust that Mr. ROSENFELD, with his well-known interest in cultivation matters will be able to settle down in the island for a lengthy period, and not be compelled to throw up his job after a couple of years, as has thus far usually been the case among scientific experts in Porto Rico.

Progress in Cane Juice Clarification.

During the past few years an increased amount of attention has been given in different countries to the important question of the clarification of cane juice by the defecation process for the production of raw sugar. Particularly in Hawaii has a closer study been made of this stage of manufacture with the object of establishing it on a more scientific basis, and of abandoning what Mr. HORACE JOHNSON calls the "hit and miss" method of treating raw juice by lime and heat. Our readers will have noticed lately that we have recorded work on a number of phases of clarification in the cane factory; thus, in our last issue we printed a very interesting review by Dr. PRINSEN GEERLIGS on the position of the science of cane juice clarification, and also an article by Mr. W. R. MCALLEP summarizing the situation from the point of view of Hawaiian practice.

We wish, however, to draw attention to a particularly useful, original, and thorough investigation on this subject which has been carried out by Mr. WALTER E. SMITH under the advice and general supervision of the Raw Sugar Technical Committee, appointed by the Hawaiian Sugar Planters' Association. Its purpose was to determine the cause of the difficulty experienced by the refiners in the filtration of solutions of raw sugars (as made in the T. H.), and if possible to devise means appropriate for remedying the conditions found to be responsible for the defect indicated. Definitely valuable information has resulted from Mr. Smith's many experiments, information of much practical value to raw sugar producers and refiners alike. It is possible here only to give a general summary of the results achieved, leaving to a future number a description of the details of the several points investigated.

It might well be thought that the difference in the behaviour on filtration of a liquor made from raw sugar and one of the same density made from pure sugar should be attributed to the influence exerted by the gums and pectins and other such impurities present in the raw sugar on the viscosity. It might also reasonably be suggested that *bagacillo* and suspended particles should be important factors in deterring the rate of filtration. But the results obtained by Mr. SMITH proved that neither the presence of the gums and pectins, nor that of the *bagacillo*, is the main cause of the difference of behaviour, if indeed either of these classes of impurities has any effect at all. He showed that it is insoluble matter present in a very fine state of division that is the responsible impurity. Two kinds of suspended matter were differentiated: (1) coarse, e.g., *bagacillo*, which can be separated by straining through very close linen cloth; and (2) fine, which was separated by passing the filtrate from the linen cloth through a thick pad of asbestos in a Gooch crucible. Coarse matter (as *bagacillo* and crystalline salts) was proved not to have an adverse effect on filtration, in fact under some conditions its presence appeared actually to increase the rate. On the other hand it was found that the very fine suspended matter has a great effect in impeding the rate, and it is this class of impurity that is regarded as being responsible for the defect of raw sugars under discussion. A solution of raw sugar from which all the very fine suspended matter had been removed was shown to possess the same qualities in respect of rate of filtration as a solution of refined sugar of the same density. But it remained to establish the identity of this very fine suspended matter. It was found to be wax; and, as the amount present in various Hawaiian raw sugars was found to range from 0·011 to 0·074 per cent., the great influence from the point of view of the refiner of a small amount of this finely divided impurity will be realized.

As to the second question, namely the discovery of appropriate means of remedying the effect due to the presence of cane wax, this also has been investigated by Mr. SMITH and the Committee, and with a positive result. Observations leading up to this result were: that factories producing good filtering sugars have clear clarified juice; that in those factories having turbid juices the "cloud" is principally wax; that cloudy juices are usually deficient in phosphoric acid; and that if the soluble phosphoric acid of the juice is above 0·03 per cent. the liquid will be clear after liming, heating, and subsiding. From this last conclusion the obvious corollary is that in the case of juices deficient in phosphoric acid a proper clarification will be obtained by adding this constituent, presumably to form on the addition of the lime during defecation a precipitate of calcium phosphate capable of carrying down the very fine wax. Alternatively, the wax might be eliminated by mixing the turbid juice with kieselguhr, and filtering it through a pressure apparatus, such as the Sweetland filter. Both these means were tried out in the laboratory, and found to give the desired result, but of course further work in the factory is necessary to establish the practicability and economy of such measures. In the meantime, it can be said that the experiments carried out by Mr. SMITH and the Raw Sugar Technical Committee have led to conclusions forming an important addition to our knowledge of the science and practice of clarification, an addition which will be appreciated by those refiners who are demanding that the raw sugar which they buy shall conform to certain standards other than those indicated by the usual analytical figures.

Notes and Comments.

Hawaii's Increasing Prosperity.

In view of the Pan-Pacific Congress at Honolulu, above referred to, it is interesting to note, according to a writer in *Commerce Reports*, that Hawaii is becoming increasingly popular as a holiday resort to the inhabitants of the western United States, and the islands have a Tourist Bureau which is very active and circulates a good deal of attractive literature to tempt visitors from the mainland. Shipping facilities are improving; 927 vessels were reported as arriving at the islands during the 12 months ending June 30th last, which is said to be the greatest number in the history of Hawaii.

The same writer points out that Hawaiian agriculturists have learnt from the post-war depression which hit the islands pretty hard the inadvisability of depending on one staple crop, in their case cane sugar: under such a system a big drop in the world's sugar prices means hard times. During the last few years much has been done to relieve this situation. The cultivation of pine-apples, coffee, bananas, etc., is growing more popular each year, while wool, hides, and skins are receiving increased attention by the farming community. The pine-apple pack of 1923 was worth nearly 29 million dollars as compared with $7500 20 years ago. How far it is competing with sugar amongst the farmers our source of information does not state, but many acres which were formerly used as pasture land, because of being too dry for sugar cane, are now being devoted to pine-apple culture, so to that extent the two industries do not clash. In any event, the sugar industry remains easily the biggest staple crop, the 1923 crop being reckoned at 540,000 tons and valued at between 60 and 70 million dollars.

The acute labour crisis of 1921 has been overcome to a great extent by the energetic and efficient efforts of the large employers of labour in securing an increased immigration of field labourers from the Philippine Islands, according to the annual report of the Governor of the islands. For the first time in 20 years, it is stated, the Japanese labourer has dropped from first to second place in the census of labourers employed in the sugar industry. He is rapidly deserting the sugar cane fields in order to take up pine-apple culture and engage in business. The Filipino labourer has generally proved very satisfactory, but he on his part displays a desire to earn enough money to return home and there purchase land to start a farm of his own.

Lord Ailwyn and Sir Robert Horne, M.P., have accepted the invitation of the British Sugar Beet Society to act as President and Vice-President for the ensuing year.

Discussing the rate of recovery of the beet industry in France,[1] a committee appointed to examine the matter reports that while good progress has been made it will probably not be until 1928-1929 before production reaches its pre-war amount.

A. Marx and J. Rozières[2] have devised a means of purifying liquid from suspended colloidal matter by the simultaneous action of centrifugal force and an electric field. They use a centrifugal machine, one pole of the source of electric power being connected by means of a brush to the top of the axle of the rotating bowl and the other to a metallic cylinder placed concentrically inside the bowl. Liquid under treatment is delivered to the base of the bowl by a conduit, the rate of flow through which is regulated by the centrifugal force, the clarified liquid being discharged through a pipe at the top of the bowl. Colloidal matter is precipitated on the walls of the bowl if of higher density than the liquid, and on the cylinder if of a lower one.

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[1] *I.S.J.*, 1924, 67.

[2] *Chimie et Industrie*, 1923, 10, 218-220; *Comptes rendus*, 1923, 176, 1396-1398.

Fifty Years Ago.

From the "Sugar Cane," April, 1874.

There was very little technical information in this number of our predecessor, but it contained an article entitled "Notes on the History of the Sugar Industry of the Hawaiian Islands," by THOMAS G. THRUM, from which it seems of interest to reproduce some extracts :—

"Sugar, its culture and manufacture, received considerable care and attention from the Royal Hawaiian Agricultural Society; and, doubtless, as much the object of its being brought into existence as anything else was to devise ways and means to promote this industry, as the published paper of the Society will show. That it has done so is plainly to be seen, for immediately following is noted an improvement in cultivation, grinding, boiling, draining, packing, etc., to say nothing of the increased interest taken in it. . . . During the season of 1851 the first centrifugal drying machine was put into operation at the East Maui plantation. Previously all sugars were dried by the old and tedious process of draining from boxes or barrels through holes bored to allow the molasses to drain off, leaving it but imperfectly or unevenly dried after all. The centrifugal gave such universal satisfaction for the improved grades of sugar and the saving of time, that it made a thorough revolution in our sugar industry, for every planter, large or small, changed as fast as their orders could be fulfilled. . . ."

"Our planters, ever on the watch for improvement, turned their attention about 1857 or 1858 to steam as the motive-power in sugar making, when the Haiku plantation was established with steam for grinding, boiling, and finishing. Another stride for improvement was in the introduction of vacuum pans for finishing, the first of which was put into operation at the Kaupakuea plantation in 1860, and the year following one was set up at Lahaina. The mode of sugar boiling on all the plantations was with these exceptions by the open train, and while our large planters were seeking to improve their works by the addition of steam strike pans, vacuum, or Wetzel pans, the number of small planters was increased by the advent of the sorghum pan, which allowed many to start operations on account of the small amount of capital required for commencement. . . ."

"The number of plantations in operation at this time (1860) were 22, of which nine used steam as the motive-power in grinding, 12 were driven by water, and one by animal power. About this time an effort was made by a joint-stock company towards the establishment of a sugar refinery in Honolulu, which commenced operations the following year, but after a struggle of six years or so it closed its doors, never having done more than manufacture sugar from the molasses from the plantations and drain the pockets of its stockholders. During the next four or five years plans were being carried out for the establishment of several plantations on the most liberal scale yet undertaken, with machinery of the latest and most improved kinds, some of which were by joint-stock companies and some by individuals. . ." Following the article was a tabulation of data relating to the different factories in the Hawaiian Islands, from which it is seen that the two largest factories (Princeville and Lewers) produced only 1500 tons each during the crop; while Wailuku and Kohala made 800 and 700 respectively; and Onomea, Pioneer, and Waikapu, each 500.

Tentative Agenda of the Sugar Section of the Pan-Pacific Food Conservation Congress.

To be held at Honolulu, Hawaii, July 31st—August 14th, 1924.

At a Pan-Pacific Union Food Conservation Congress to be held in Honolulu during the first fortnight of August next, it is proposed to have a Cane Sugar Section, the agenda of which has been drawn up by the Hawaiian sugar technologists tentatively as follows:—

1. *Sugar Cane Insect Pests and their control.*

   Stalk borers; leaf hoppers; root grubs; aphis and scale insects; army worms, etc.; locusts; miscellaneous pests.

2. *Rodent Pests of the Sugar Plantation and their control.*

3. *Sugar Cane Diseases and their control.*

   Mosaic; sereh; Fiji disease; gumming disease; root disease; miscellaneous diseases.

4. *Improvement of Sugar Cane.*

   The propagation of seedlings; breeding for disease resistance, general hardiness, and ability to ratoon; methods of selecting and testing seedlings; "bud selection"—its role in cane improvement; sugar cane varieties and their identification; interchange of varieties between different countries with due regard to quarantine precautions.

5. *Sugar Cane Field Practices.*

   Cultivation; seed cane; soil fertility; use of fertilizers; cropping cycles; weed control.

6. *Development and Conservation of Water Resources for Sugar Production.*

   Artesian supplies; surface flow; relation of forest cover to water resources.

7. *Manufacture of Raw Sugar.*

   Cooperation of field and factory; milling; clarification; boiling-house methods; chemical control; by-products; transportation and storage of raw sugar.

The Sugar Section of this Congress is open to technologists from all over the world and it is hoped by the promoters to collect a representative gathering of sugar men to take part in the discussion. Any interested in the venture and desirous of participating are requested to communicate with Mr. H. P. AGEE, of the Honolulu Committee (P.O. Box 411, Honolulu; Cable address: "Experiment," Honolulu), who will do his best, we doubt not, to provide for their suitable reception.[1]

New companies recently registered in the U.K. include the following: International Sugar and Alcohol Co., Ltd., Kinnaird House, 2, Pall Mall East, London, S.W. 1. Private company; capital £250,000. Hammonite, Ltd., Marconi House, Strand, W.C. 2. Manufacturers of activated carbon, etc.; capital £200,000.

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[1] We discuss this Congress and its objects under *Notes and Comments* (see page 177).—ED., *I.S.J.*

Farm Practice in the Hawaiian Sugar Plantations.

In present day sugar production, the cost of the canes is a much greater item in recurring expenditure than is the making of sugar from them. And there are several factors which tend to increase rather than lessen this difference. The land is getting steadily poorer; the tracts of virgin soil in the tropics which have in the past led to the idea that it was only necessary to "tickle" the soil for abundant yields are fast disappearing; and the older lands are suffering from the greater demands made on them in order to produce a satisfactory balance sheet at the end of the financial year. In the second place labour is becoming less abundant the world over, and therefore wages are rising. Lastly, the processes of manufacture are being steadily improved and losses in the mill reduced to the lowest possible figure. As shown in last month's issue of this Journal (p. 124), the pre-war cost of raising the canes and delivering them to the factory was, in Hawaii, 5½ times that of manufacturing the sugar, and the proportion will presumably be even more striking under the present conditions of labour stringency there. This latter aspect of the Hawaiian sugar industry was referred to as long ago as August, 1922[1] as follows :—"The mere supplanting of man-power by animals or machinery will not suffice, but the very fundamentals of cane cultivation must be dispassionately passed in review. The whole work on the plantation is in the melting pot; and no practice, however sacrosanct by tradition, can be allowed to escape the severest overhauling. As will be seen in the sequel, hilling-up of the canes, off-barring the ratoons, stripping the canes before harvesting, the planting of tops, the cutting up of mature canes for seed, and even the method of application of the customary heavy doses of artificials, have all of them been subject to considerable criticism, and various modifications involving less labour have found local favour as the result of experiment during the last year or two."

The best evidence that the issues thus raised have been taken seriously by the planters can be obtained from a perusal of a report dated October, 1923,[2] on Cultivation and Weed Control on which most of the following observations are based. In the first place, it must be noted that cultivation in its widest sense is of comparatively less importance in irrigated than in unirrigated plantations. Irrigation is of course vital for the large sugar estates on the dry western sides of the islands, where there is an abundance of sunshine and heat and practically no rain: the growth of the canes in these is very rapid, and thus the weeds are quickly overtaken and smothered by the closing in of the cane rows. On the eastern sides where heavy rainfall occurs (100-300 ins.), matters are reversed; the air is cooler and there is much cloud, both of which interfere with the rapid development of such tropical plants as the sugar cane, and their growth is often checked to a considerable extent. On the other hand the weeds, being of less tropical nature, grow extremely luxuriantly, and heavy artificial work is needed for their destruction. The writer of the report referred to frankly confines himself to a study of the practices on unirrigated plantations in the islands. And while admitting that all of the operations have not as yet been fully investigated, he considers that a certain amount of light has been thrown upon their relative value, and therefore some progress can be reported. It will be seen that evidence is adduced to show why some of practices "sacrosanct by tradition" are likely to go by the board and disappear entirely from the current farm practice. Upon reading this report another interesting question arises or it suggests itself that it will probably soon arise, namely whether the future of the industry will see a yet more abundant application of fertilizers, for which the Hawaiian practice is so famous, or take an opposite direction, and result in an attempt to bring up the cultivation to the same high state of efficiency as the work in the factories. These two lines of work are not, of course, mutually exclusive. But it occurs to the writer that any general large increase in the application of nitrogenous manure may be fraught with a certain amount of danger.

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[1] *I.S.J.*, 1922, p. 396.

[2] Report of the Committee on Cultivation and Weed Control. H. E. STARRATT. Presented at the Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.

It is true that laboratory experiments would seem to indicate that the sugar cane plant, under certain conditions in Hawaii, may be able to withstand "any application likely to be made under field conditions."[1] In another observation, on a field scale, the current practice of burning the trash has been shown to "indicate no depletion of the organic carbon content of the soil," the roots and stubble being presumably sufficient for keeping this up. And there are numerous suggestions that the leaching action, of the heavy rains or irrigation, upon such soluble manures as sodium nitrate have been somewhat exaggerated, a better retention of this salt having been noted in the field than in lysimeter experiments.

But there is a wider point of view, which will doubtless receive due attention, namely, what ultimate effect such heavier applications will have upon the plant and soil respectively, if they become *stereotyped*. The sugar cane plant is often grown at present under highly artificial conditions, and the tendency is for it to become less and less tolerant of soil not in a perfect physical (and chemical) condition. It is, so to speak, more delicate than it used to be, in spite of the fresh vigour imparted by the introduction of seedling canes ; and, just as modern society is suffering from a multitude of apparently new and serious disorders, this is always the case with plants when they are removed further from their natural environment. It will require a longer trial before any forward step can be taken with confidence along this line of increased fertilizers ; and, independently of its effect upon the constitution of the plant, similar remarks suggest themselves with regard to the structure of the upper layers of the soil—chemically, physically and biologically. There are indeed signs that the economic optimum is being at any rate approached, for is it not a fact that the cane juices in Hawaii are deteriorating year by year ?

None of these doubts cross the mind when turning to the other line now being rapidly opened up, namely, the improvement and simplication of the cultivation practices *per se* ; and there is abundant evidence that marked changes are being made in current farm practice as the result of the attention being devoted to the matter. In some respects, indeed, considering the depreciatory remarks regarding such highly artificial processes as hilling up and off-barring, there is some approach to more natural conditions. This line of work is, obviously, the more difficult of the two, the attempt being made to increase the efficiency of clean cultivation and, at the same time, to decrease the cost : it is a much easier matter to add an additional dose of artificials. One interesting experiment referred to below compares the results obtained by these two methods ; and, as we read it, clean weeding without manuring has much the same effect on the sugar produced as heavy manuring without attending to the weeds. This makes it all the more important to determine as early as possible the ultimate effect of stereotyping these practices, both on the constitution of the plant and on the general "sanitation" of the soil ; and it will be interesting to see how far these two divergent lines of work are followed up by the Hawaiian planters.

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[1] *I.S.J.*, 1924, pp. 76-77.

The Report deals with plant canes and ratoons separately.

(1) *Plant canes.*—The preparation of the land for planting has been greatly simplified by the introduction of tractors as against the old time mules, and the aid of new types of ploughs, sub-soilers, harrows and cultivators consequent on this change; and the work has been considerably speeded up. This time element is of great importance in the large plantations, especially as regards the period allowed for weathering between preparation of the land and planting the seed.

The first operation is the burning of the refuse of the previous harvest, but it is claimed that, with well sharpened disc ploughs, quite a considerable amount of trash may be incorporated with the soil when the old stools are ploughed out. The steam ploughs which are so successfully employed on the more level irrigated plantations are not available, but tractors are replacing mules on the more irregular unirrigated estates and, as mentioned, greatly facilitating the work. Of the new types of ploughs being introduced with the tractors, the most important are of the disc type, which are replacing the mould board. After a period for weathering, tractor-drawn Kilifer harrows or heavy frame toothed harrows are used; and subsoiling, with a vertical bar and short cross piece reaching down 18-24 ins., breaks up any hard pan or packed earth.

If liming is employed it may now be undertaken. The uses of lime are various, and it is not only to be regarded as a fertilizer. After nitrogenous manuring it assists in nitrification; and where potash is a limiting factor additional quantities of this are rendered available by the lime. It further improves the physical character of heavy soil, rendering fine soil more pervious to water, air and roots, besides rendering all subsequent cultural operations easier in consequence. Thus far applications do not seem to indicate much improvement even in residual effect; but in the form of coral sand at Olaa good results have been obtained. It must be, however, borne in mind that in soils deficient in potash any improvements may be entirely due to the increased amount of this substance. The popular practice appears to be 8-10 barrels per acre, and two tons of coral sand were applied in the experiments with this substance.

The second ploughing is performed after all those mentioned above, and either by a reversible disc plough or any other implement suited to the local conditions. After it the furrowing is taken in hand. Formerly it was, and often still is, done by mule-drawn double mould board ploughs; otherwise now by tractors with one or two ploughs attached. The popular distance apart of the rows is 5 ft., giving ample space for interculture till the cane leaves meet and smother the weeds. At higher elevations growth is slower and the canes are more erect, so that the favourite distances apart are 4 to 4½ ft. In furrowing a further sub-soiling may be done if necessary, the earth in the bottom being stirred from 4 to 12 ins.

Planting varies with climate and soil and differing methods are called for. The chief varieties grown are Yellow Caledonia, D 1135, Yellow and Striped Tip, and H 109; and the acreages according to a recent census were 31,370, 7873, 3002 and 2144 for the first four respectively. One to two-year old canes are considered the best for planting material, and the sets are placed in the trenches horizontally or inclined at an angle. The latter is supposed to prevent rotting at the base, while during drought the lower part being deep buried may be expected to survive. A continuous row of cane appears to be the rule, the pieces being put butt to butt; but the author found that spacing the sets 1 ft. apart produced 24,306 canes per acre with a saving of half the seed.

(2) *Ratoons.*—The alterations noted in the Report dealing with plant canes thus appear to be mainly in the implements appropriate to the introduction of tractors, with little change in the actual operations performed. The case of ratoons is very different; various rather complicated local practices have been developed, and these are known under special names, which in most reports are, naturally, not explained, and leave the outside reader with a sense of doubt as to their exact meaning. Such terms as palipali, off-barring, stool shaving, hilling up, stool splitting, kuakuas, although sometimes conveying a fairly obvious meaning, need accurate definition, especially as to the reason for the operation and the exact time of its application, before other workers can benefit by the results of the experiments. The present Report supplies these wants admirably, and the short descriptions are accordingly reproduced. All of these processes are discussed and their usefulness as the result of experimental tests.

Palipali.—This operation consists of cutting down any very long stumps left by careless cutting and by dragging the trash away from the cane rows into 'the *kuakuas*, or spaces between the rows. It is hand performed by the hoe. The trash is intended as a mulch for smothering the weeds, but this it only succeeds in doing to the erect growing weeds and keeps them in check until the cane gets a good start. It is unsuccessful with the *honohono*, apparently a succulent, sprawling grass which, starting its growth in the damp material, soon emerges and spreads over the trash surface. If the trash is burnt, *palipali* becomes unnecessary and a good deal of *honohono* is destroyed. *Palipali* is obviously an expensive operation.

Off-barring.—This term also requires explanation. When level cultivation is practised or during 1st or 2nd crops it is unnecessary; but when the stool gets older it spreads outwards and then it is customary to cut away the new growth. This is done either by a 12-14 in. plough drawn along the edge of the stools, trimming them down to a squared strip 10-18 in. wide and 4 ft. 6 in. high, or by a double disc plough drawn by tractor, which cuts the stool perfectly and throws a good deal of soil into the *kuakua*, completely covering the weeds and trash. Experiments have shown that this off-barring decreases the yield of canes, although its value in weed control cannot be ignored. The covering of soil quickly rots the mass under it, and the soil thrown on helps the subequent implemental work.

Stool shaving.—After cutting the canes, new shoots arise from the base of the old stumps and other parts of the stool, and as years pass this fresh tillering not only broadens the stool but raises it till it is, so to speak, perched high above the *kuakua*, with a mass of rotten roots below. To put off the expense of replanting as long as possible, an implement was devised to cut off the stubble just below the ground surface. But although mechanically perfect and supplanting the heavy work of *palipali*, it was found that the stool could not stand the treatment, and reduced yields resulted. This reduced yield must be off set by the saving experienced in subsequent hoeing, and may yet prove to be a profitable practice.

Stool splitting.—This is done by "drawing a heavy implement with a rolling coulter to split the stools longitudinally through the middle, together with a subsoil plough to open up the area between the cane rows." The idea was to encourage the lower buds to shoot and to create fresh root growth; and the device has been so improved that splitting, off-barring and subsoiling can all be done in one operation. But here again this drastic treatment resulted in a reduced yield; it is the natural thing for the plant to spread outwards, and one cannot prevent it from doing so without introducing a highly artificial condition.

Hilling up.—This practice, formerly carried out in all cane crops and on all plantations, is now falling more or less into desuetude. It consists of loosening the soil in the *kuakua* by an 8 in. disc plough, and throwing the loosened earth with the weeds or trash on to the base of the stool by a celery hiller or other implement. Hilling up is the last operation in cultivation and is performed at the time when the leaves of adjoining rows meet. It is supposed to loosen the earth and destroy the weeds, cover the manure and give better drainage, and also lend support to the cane stalks. But it has been very sharply criticized. It is pointed out that the cane roots are by this time right across the *kuakua* and are cut off by the hilling up; at the same time the fertile soil is heaped up against the plant and thus put out of action, while a V-shaped depression is made in the centre of the *kuakua*, going right down into the sterile subsoil, and forming a splendid starting point for erosion during heavy rains. The feeding organs are restricted just at the time when they should be thrown out as far as possible into fresh areas. As might be expected hilling up also results in a diminished yield of canes.

Considering these criticisms of the four operations, off-barring, stool shaving, stool splitting and hilling up, one is led to wonder how it is that these practices ever became part of the current farm routine in the Hawaiian cane fields, and perhaps to suspect the influence of Louisiana, where of course the conditions are diametrically opposed. In each case some support is given to the practice by help rendered in weeding operations, but the treatment of the unfortunate cane plant is obviously contrary to nature, and it is not to be wondered at that reduced yields are usually obtained. It is interesting therefore to turn to the simple operation of cultivating in a narrower sense.

Cultivation.—The Planet Jr. and Horner's are the most popular cultivators, for weed destruction between the rows of canes. The former is usually passed 3-4 times along the *kuakuas*, breaking down the weeds and scratching the soil to 2–3 ins.; if harrowing has not been done the Planet Jr. causes more rapid decomposition of the trash by turning it over and mixing it with the weeds and fine soil. The HORNER cultivator is used after hand hoeing, and drags the weeds into piles and covers them with earth; by the next hoeing these are well rotted and the Planet Jr. if run along breaks up and spreads this decayed matter. These operations are continually repeated until the fields are free from weeds. As an example of the value of weed control an experiment at Kilauea showed that it increased the yielded by 7-8 tons of cane per acre, while fertilizing increased it by 9 tons. Thus clean weeding without manuring and manuring without clean weeding were of practically the same value as regards yield.

Some of the other experiments were as follows, although there is not space to give details. In one experiment the regular practice of off-barring, middle breaking, hilling up, etc., gave practically the same results as weed control alone. At Hakalau a gain of almost 1 ton of sugar was obtained by hoeing by hand instead of animal cultivation: and plots not off-barred gave half-a-ton of sugar more than those that were. In Hamakua no apparent difference was obtained by the various stock treatments, and it is therefore suggested that the cheapest method should be adopted, with special consideration of the saving of man-days in times of labour shortage.

Other methods of weed control. Paper mulch.—This is used in a few places under special conditions, and successfully too. At Olaa the soil in the lower levels is stated to have quantities of rocks, whereas in the upper reaches the soil is shallow and the rains heavy. The ordinary methods of cultivation are thus rendered difficult and the practice of covering the soil with bagasse paper saturated with asphalt and oil has been adopted. After harvest the trash and weeds are *palipakied* to the *kuakuas*, and a strip of this paper 30–35 ins. wide is spread right over the cane row and held in place by suitable weights. In a few days the canes begin to pierce the paper and develop normally. But, because of the unevenness of the covering, some shoots expand below it and "tenting" occurs: this is corrected about three weeks later by cutting the tented areas longitudinally when the shoots emerging lose their etiolated appearance and grow normally. This method destroys the ordinary erect weeds, but *honohono* again is unaffected, growing luxuriantly below the paper and subsequently above it if not checked. In the rainy season hand hoeing or a modification of the Planet Jr. cultivator is the only means of combatting the weeds.

Spraying.—Sodium arsenite has proved effective. The stock solution is made by mixing 2 lbs. white arsenic with 0·42 lbs. of caustic soda and boiling till clear; for spraying *honohono* dilute to 25 galls., and for other weeds to 10. The addition of 1 lb. soap to 100 galls. acts as a spreader, and causes the solution to stick to the surface instead of rolling off in drops. The solution is stated to be only effective on the surface touched and, what is more important, even after thorough saturation the effect on the soil is only temporary.

Stripping.—This operation of ridding the cane plants of their dead leaves (found useful in damp conditions in various countries) has been much discussed in Hawaii. Experiments show that it is expensive and certainly the neat and orderly appearance of fields so treated has helped to perpetuate the practice. It has however been shown that on the whole stripping results in a loss of labour and money.

C. A. B.

A Beneficial Aspect of the Sugar Cane Mosaic Disease.

Some Historical Musings—and a Prophecy.

By ARTHUR H. ROSENFELD,

Special Technologist for Cane, Insular Experiment Station, Rio Piedras, P.R.

Some fifteen years ago, when the boll weevil scare and excitement was at its apogee in Louisiana, the writer was on a Farmers' Institute trip with officials of the Experiment Station, College of Agriculture and Crop Pest Commission in the then recently infested area of the north eastern section of the State, where an assiduous campaign was being carried on to discourage the negro hands from leaving the plantations in a panic, through demonstrating the feasibility of not only making cotton under boll weevil conditions, but of also carrying on better farming than before because of the absolute necessity of diversification of crops under the new conditions. In one of his talks the author took occasion to remark that, on account of its stimulus to more intense agricultural investigations and the application of scientific principles in the hitherto one-crop cotton areas, the time would come when the farmers of the South could justifiably erect a great monument to their genuine, although unwitting, six-footed benefactor. The writer well remembers the surprised scepticism with which this remark was received, not only by his rather shocked audience, but by a number of his colleagues on the rostrum as well—in fact it was rumoured that dire vengeance was threatened by certain of his hearers for his cynicism.

Last Spring, while in the State of Alabama, the author had called to his attention preparations for great festivities in connexion with the dedication of a public memorial fountain in the little city of Enterprise, Alabama, the centre of a rich agricultural section which, forced by the boll weevil some years ago to abandon its mono-culturistic system of cotton growing, has developed into one of the most prosperous diversified agricultural districts of the State. The writer felt that he had been almost uncannily prophetic years before in the Pelican State when he learnt that this fountain was dedicated by a gratefully enlightened community to a strange benefactor—the *boll weevil.*

It is a trite, but very true, saying that "It's an ill wind that blows nobody good," particularly when applied to the great agricultural plagues which have presented themselves from time to time in different parts of the world. No more classic instance could be cited than the advent of the pernicious San José Scale, in the United States a generation or two ago when millions of trees all over the country were destroyed by this pest, when orchards were abandoned by the thousand and nurserymen put out of business by the score. But who will say to-day that the San José Scale, as feared and as fatal as it was but a score of years ago, has not been of direct benefit to the horticulturists of the United States through the implantation of a very general spraying practice, better pruning and cultivation all along the line and more attention to varieties and the proper marketing of same? The writer well recalls, when a boy in Virginia before the San José Scale was the familiar term it afterwards became, buying the best of apples for the equivalent of a shilling or so per bushel, but to-day that same fruit, sprayed, washed and graded, easily brings from four to eight or even ten times the old prices to the growers, who have learnt by better orchard practice to control, not only the San José Scale, but other insects and diseases which, while before taking their heavy yearly toll of the orchardists' profits, either passed unnoticed or were not considered of sufficient importance to warrant what were then considered "high-falutin," and expensive control measures.

In the agriculture of the sugar cane we have many striking examples of such blessings in disguise, but none more typical than the outbreak and spread of the notorious "Sereh" disease in Java. That this disease cost the Java planters many millions of florins there can be not the slightest doubt, nor that it brought great hardship to the sugar industry of that productive island for several bitter years, but there can equally be no doubt to-day that the stimulus given to the production of disease-resistant and generally more prolific varieties by the ravages of the "Sereh" in the old Cheribon cane of the island has resulted and is resulting in the gaining of infinitely more millions, not only in Java, but in other countries as well, notably Argentina, where certain of these varieties, developed solely as Sereh-resistant, have turned out resistant to other diseases also and so much more prolific than the varieties formerly generally grown there that the Java varieties have replaced these earlier varieties almost in their entirety.[1]

Just as the benefits resulting from investigations and practices forced upon the Javanese technicians and planters were not confined to the planters of Java, but, when applied in Argentina through the Tucumán Sugar Experiment Station, practically saved the sugar industry in that country from extinction, so Argentina's experience has resulted not only in practically doubling the yield of cane per acre in Tucumán, but has materially aided Porto Rico in solving her Mosaic or Yellow Stripe disease (*Matizado*) problem, this disease but a few years ago threatening to sweep over this island as disastrously as did the "Sereh" over Java but a short score of years agone. The Kavangire[2] or Uba cane, which, while immune to the

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[1] See *I.S.J.*, 16, pp. 12-23; 21, pp. 488-493; 21, pp. 606-8.

[2] See *I S.J.*, 22, pp. 26-33.

Mosaic disease in Argentina, requires for reasonable maturity a longer growing season than that subtropical country affords and was not a large factor in the meeting of Argentina's Mosaic problem, when sent from the Tucumán Experiment Station to that of Porto Rico proves not only to be the only variety yet definitely found immune to this disease, but also to give quite good sugar content and purity in many sections when left for from fifteen to eighteen months before harvesting and always to give an agricultural tonnage far in excess of any other variety amongst some five hundred tried out on the island. Java (P.O.J.) 36, 105 and 213, always infected with Mosaic in Tucumán, but extremely good yielders in spite of it and the canes which have largely replaced all others in Tucumán, when sent from Argentina to Porto Rico, show the same tolerance to Mosaic as in Argentina and appear to yield here just as heavily in proportion to the Striped Cheribón, Cristalina and Otaheite, even when these very susceptible basic varieties in Porto Rico are free of Yellow Stripe, as in Argentina. Hence, these varieties which, but for the epidemic of Mosaic Disease in Porto Rico would probably never have received particular attention here, as is evidenced by the fact that they were sent from Argentina several years before the general epidemic of Mosaic here and had received no particular attention when Mr. F. S. Earle began his epoch-making work on the varieties on the island, are to-day, wherever planted, yielding easily *twice as well as the old staple varieties*, even when the latter are uninfected. Besides these varieties, which all have the defects of thinness and high fibre content, the Federal Experiment Station at Mayaguez, the Insular Station at Río Piedras and Centrals Guánica, Fajardo and Aguirre have all developed native seedlings in abundance and imported foreign ones, amongst the most generally promising of the latter being the BH 10/12 (known locally as the Barbados Hybrid) and the SC (San Croix) 12/4 seedlings, and the Mosaic outbreak has vastly stimulated trials all over the island with these new canes, many of them far better in every respect than the canes formerly so generally grown.

Mr. Earle developed the process of "rogueing" the fields, which has become quite general and very effective in the lighter infected districts and these periodical reconnaissances of the fields have resulted in the canes generally getting better attention than ever before—in the field-men learning to recognize other diseases as well as Mosaic and being generally more observant than before, an well as realizing, as even the peons in Argentina now do, that cane is not "just cane," but that there are great differences, advantages and defects in distinct varieties under distinct conditions. The result is a healthier interest everywhere apparent in the field, where, as the author has so frequently insisted, *our sugar is really made.*

In the heavier infected districts, where eradication by "rogueing" would be too expensive and impractical, the Uba cane is beginning to be quite generally planted and the mill-men are beginning to weaken in their opposition to grinding this thin, fibrous cane, for on their own properties they are doubling their tonnage and cutting their cultivation costs in half through the use of this cane and they have pretty well learned that, as far as buying cane is concerned, in many cases it is now "Uba or nothing." The writer recently visited a planter whose Striped Cheribon and Cristalina canes had been practically wiped out by the Yellow Stripe a few years ago. Before the disease invaded his hill-land fields, his average annual yield was about 15 tons per *cuerda* (acre). Two years ago, on the advice of the Insular Experiment Station, he started planting Uba and he estimates his crop this year at 35 tons per acre, an estimate which the writer considers extremely conservative.

In the heaviest infected districts along the west and north-west coasts, where their very general infection with the Mosaic is no longer a disadvantage in view of an almost complete infection existing in the fields, the tolerant P.O.J. 36, 105 and 213 are being employed on a large scale and with most promising results. In these sections, where the Java varieties are growing alongside the Striped Cheribon (Louisiana Striped) and Cristalina canes which they are rapidly replacing, the appearance of the field is very similar to that presented by the Tucumân canefields 10 years ago—a broad expanse of yellowish, low-growing cane where the Cheribon or Cristalina is growing, then a wall of dark, rich green rising 2 or 3 ft. sheer above the other, indicates one of the Java seedlings or the Uba cane *of the same age and on the same soil.* The writer but a fortnight ago visited a plantation in this district, which place almost entered bankruptcy but a couple of years ago due to the havoc wrought by Yellow Stripe, the average yield per acre having declined to around 10 tons. The manager of this plantation started planting the Java varieties and Uba on these good low lands only two years ago, yet, on going over his fields with him, the author agrees that he ought easily to average 30 tons per acre this crop, *including a large area of Striped Cheribon and Cristalina which has not yet been replaced by the newer canes.* This is a far higher average yield than this place ever made before the advent of the Mosaic disease.

Porto Rico, then, has suffered from the Mosaic disease—yes, suffered greatly. Splendid fields have fallen to ridiculously low yields, factories have become bankrupt and many individual fortunes have fallen before its onslaughts. But the island emerged from its travail with far higher yielding of cane much more generally cultivated than before, with far better attention being given to the field end of her sugar industry—by far the most important end, be it said—and with a vastly better trained agricultural class than ever before. Have not the good more than compensated the bad effects ?

And, now, a word in conclusion in regard to Mosaic's future relation to the world's largest sugar producer and, therefore, the most potent factor in the world's sugar prices—Cuba. Last Spring the author spent some six weeks in that island with the idea of informing himself on the prevalence of Mosaic disease and on how much of the damage to the crop then being ground in the provinces of Oriente and Camagüey in particular might be attributed to *Matizado* as well as to the drought which was receiving credit for all of the damage. In general he found the executive officers in Havana little alarmed about or interested in Mosaic disease, but it took but a few trips into the interior to convince him that Mosaic was very widespread and doing quite considerable damage, this being particularly the case in the two largest sugar provinces which are at present being most heavily and expensively developed—Camagüey and Oriente. Everywhere he went in Cuba he found more or less Mosaic, but the infection was decidedly heaviest in these more recently developed sugar provinces and, unfortunately, the very two provinces where agricultural practice is most rudimentary [and the *colonos* most widely scattered. In large parts of these provinces agriculture as such is unknown. The magnificent virgin forests are cut, the trees lopped off at any height and generally not even the hard woods are taken out, the object being to get in so many *caballerias* of cane and "not to go into the lumber business." The tumbled forests are then haphazardly burned over, the partially burned trunks, as well as the tall stumps, being left *in situ*, the field presenting a most hopeless appearance. Then very often cane seed-pieces are simply stuck into a hole in the ground wherever a space for same can be encountered—*and the field is planted!* Naturally, no cultivation worthy of the name is possible, the land is baked by the sun and beaten by the rains and the moisture during droughty periods rapidly lost through the unmolested capillary pores. At harvest the cane is frequently cut very high, due to the natural obstacles to more efficient harvesting, the best part of the cane being thus lost and the height of each succeeding cutting raised *per se*. Due to the immense fertility of these virgin soils, even under these conditions the fields will yield from six to ten fairly remunerative ratoon crops and, when these finally run out, the land, which is just in best physical condition for proper agricultural practice, is declared *agotada*—exhausted—and new virgin lands are cleared and the above vicious circle repeated, with all the expensive railroad construction and heavy haulage costs which the planting of cane further and further away from the centrals signify. The result is that thousands upon thousands of *caballerias* of the land closest to the factories are abandoned as worn-out when, with proper aeration and even reasonably fair cultivation, they could be made to yield excellent crops of easily and cheaply deliverable cane with better sugar content than the extremely fertile virgin lands. As a matter of fact, as compared with the old—in some cases 50 to 100 years old—canefields of Louisiana, Argentina, Java or Porto Rico, these lands *are* virgin lands in every sense of the term. Cuba must face this problem very shortly, for the end of these virgin lands is beginning to come into sight with the enormous expansion of cane plantings which in a comparatively short span of years has brought the island's average annual sugar production from one and a half million to four million tons—over a fifth of the world's total—and it appears to the writer that the Mosaic disease is going to be one of the prominent factors determining its very early attack.

It is not desired to convey the impression that the methods—or lack of them—above outlined are absolutely general in the provinces of Oriente and Camagüey, for on some of the large sugar estates in those provinces one sees a fair amount of cultivation and few of them are very well attended to on the field side, but in a large part of Oriente and Camagüey these conditions as outlined are quite representative, particularly in the *colono* fields, over which the centrals have little or no control whatsoever and which are going to constitute one of the most difficult problems in combating Mosaic disease, for its control must be to a certain extent on a co-operative system and the only methods of attack are through careful supervision of the fields and improved agricultural methods, which include, naturally, the selection and propagation of improved resistant or immune varieties.

It can readily be seen, then, that, with conditions as above described only fairly general, Cuba is facing a genuine crisis if the Mosaic disease manifests itself in that island with anything like the same virulency and powers of distribution as it has shown so strongly in Argentina and Porto Rico. The writer sincerely hopes that this prediction will never be verified, but he is frank to say that he left Cuba with a strong conviction that, if the Mosaic disease spreads as rapidly and with as deadly effects in Cuba as it has done in those other sugar countries, the annual sugar production of the island may drop as low as three million tons before it reaches the five million which are warranted by the large recent extension in cane plantings.

And the blessings so well disguised? They will come to Cuba, as they have come to Java and to Tucumán and to Porto Rico, in the form of better cane varieties and more intelligent cane husbandry, in the larger eventual yields and the employment of the so-called "exhausted" lands at a convenient distance from the factories, in a larger measure of co-operation between grower and manufacturer and, best of all for the future of the island, in the building up of a genuine agricultural class in the newer district of Cuba where so many, who were never agriculturists in any sense, have been drawn into cane "cultivation."

These are the good things which the ill wind of Mosaic will eventually blow into Cuba's fertile cane fields.

The Locust Menace in the Philippine Sugar Cane Fields.

The locust appears to be one of the most serious pests of the cane fields in the Philippine Islands, and consequently a good deal of attention is being paid to it there.[1] In a "plague" year numerous swarms settle upon the cane fields feeding voraciously on the leaves, and reduce them to a mass of skeleton plants. It has been noted that these pests have visited the islands recently in cycles of four to six years; thus 1913-16 were bad years, 1917-20 were free, while 1921-23 have again been bad. The loss in the southern part of Luzon alone in 1922 is estimated at 1,500,000 pesos (the peso being about 2s. 2d. in our currency). Large sums have been set aside for fighting the pest, and in Mindoro the sum spent in 1922 was 40,000 pesos besides a like amount among the planters, and in Negros 50,000, while in 1923 the total cost in the Philippines is estimated at 200,000 pesos. With these facts before them, it is not to be wondered at that efforts have been made by those concerned at standardizing the various campaigns and taking common action, especially as it is considered that an outbreak has a marked effect in the lowering of land values. But, as no special investigation appears yet to have been commenced, it is felt that the first piece of work to be undertaken is to gain exact information concerning the life history, places of origin, causes of invasion and best methods of control. A scheme has been propounded for the employment of a whole time specialist for this purpose, the estimated cost being put down as 50,000 pesos. One of his first duties would be to study the effectiveness of all previous campaigns, to suggest economies as to labour employed and to determine which particular form of attack is best suited for each district.

When a swarm alights, there is always a chance, unless they are driven away very promptly, of their leaving a heritage behind them in the form of eggs laid in the soil, with a resulting mass of immature forms or "hoppers" in the following season (February to March). An experiment is recorded of driving a swarm which had been observed to commence laying on to land already ploughed, and after laying had been completed driving them away again. Part of this area was then ploughed by steam tackle to a depth of 12 in., and another part shallow "ploughed" by the ordinary country ploughs. As a result of this differing treatment, the deeply ploughed portion was seen next spring to be comparatively free from hoppers while they swarmed in countless myriads on the shallow ploughed area. But many of the swarms do not lay their eggs within convenient reach, but in waste stretches among the inaccessible mountains which form so large a feature in the islands of the group, or indeed in entirely different and less thickly populated islands. And therefore the difficult task of locating the laying grounds must be undertaken before any effective control can be assured.

There are various methods of dealing with a locust attack. The mature insects must be kept on the move; and as much commotion as possible is introduced by the natives in the presence of a swarm, from tin cans rattled by women and children to rockets and flame jets by the men. The new brood of hoppers, when accessible, can be dealt with and collected or destroyed by the "corral" method, which consists in dragging sheets of iron across the land and the hoppers with them till they are thrust into previously dug trenches out of which they cannot climb. The young locusts are a valuable article of food, thus an offer of one peso per bag made by the Locust Board met with little or no response, it being found that the local market value was considerably more than this. Similarly, all spraying, poisoning or otherwise destroying was looked upon with little favour, as rendering the insects unfit for consumption. Besides these methods others are employed against locusts, such as poison gases, repellants in the fields and the introduction of insects and other natural enemies, and it is more than necessary for all of these to be examined from an economic point of view by a specialist. A distinct improvement of the form of corral usually employed has recently been announced in a bulletin of the Department of Agriculture in the Federated Malay States,[1] whereby, in place of the cumbrous and costly iron sheets, calico is used with a strip of cloth next to the ground over which the hoppers will not crawl. And, further, the apparatus is so arranged that ditches are entirely done away with, the hoppers being caught in the angle of the cloth and securely bagged as the apparatus moves over the ground, these bags proving capable of being used over and over again. The hoppers can thus be taken as soon as the bags are filled and carried off to be sold in the market. These improvements are to be introduced into the Philippines at once.

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[1] *Sugar News*, Manila. June to September, 1923. The details to hand from which this note has been prepared are disjointed and meagre, and it will be interesting to have a connected and authoritative account of this pest, which it may be hoped will shortly appear.

It is pointed out that, in previous years, the locust campaigns have not started till the latter half of June when, presumably, the swarming was in full force and comparatively little could be done; and an elaborate scheme has been developed in the Pampanga district of south Luzon, where the greatest losses have occurred in the past; and this scheme promises to ensure a fairly complete control of the pest, if persevered in. It is primarily in charge of the Pampanga Sugar Mills, with an extended system of co-operation between the general population, the planters with their labour, the scientific staff and employees of the mills, the Agricultural Department, the Railway, and Municipal and Provincial authorities. The two outstanding problems are the provision of transport and materials. The Centrals give free use of their rolling stock, several trains being set apart exclusively for the transport of the labour, and attend to the purchase and distribution of materials; 2000 nets have been purchased during the year for the areas near the factories and additional ones for the more distant parts. The area is divided into two sections termed the "inside" and the "outside," and the Centrals are in charge of the former. The latter is attended to by the Manila Railway which gives free passenger traffic for those engaged in the campaign and, presumably, facilities for the transport of materials. Extra labour is easily recruited, for all are interested in the protection of their crops, and the work is popular, as stated above, because of the food value of the locusts; but a fixed wage is arranged, and the total cost is shared in definite proportions by the various bodies co-operating. The whole area is linked up by telephone communication, so that at the shortest notice bodies of men can be hurried into action within the entire area. The swarms have thus been kept constantly in motion, with the result that very few hoppers have appeared during 1923 and comparatively little damage has been done. The whole cost worked out at a few centavos per ton (of sugar ?).

All the flights are carefully watched, and indeed followed up by a body of scouts, to find out the natural breeding grounds. But it is obvious that this matter cannot be dealt with fully under the existing system; and it is proposed that a battalion of constabulary should be set apart and trained in the latest methods of dealing with the eggs. Some of the laying grounds have been found to be only economically reached by aeroplanes, and these have apparently been already utilized in certain places. It is estimated that, for a standardized campaign, 200,000 pesos will be needed, of which 150,000 would be used for the training and upkeep of the battalion and the rest, apparently, for the research work. But these figures are comparatively small when considering the losses to which the crops are liable, and the cost would be divided up between the various participants in the scheme. Locust control is obviously becoming rather a national than merely a local matter.

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[1] The Malayan Locust. H. C. Pratt.

C. A. B.

Boiling House Recovery with High Mill Extraction.[1]

By W. van H. DUKER.

Managers of factories in the T.H. were invited to state their experience in regard to the position of boiling house recovery, and the following is a summary of their replies.

Mr. HORACE JOHNSON submitted a copy of the true average figures obtained from all of the C. Brewer & Company mills for the years 1912 to 1922 inclusive.

Year.	No. of Mills.	Purity of First Mill Juice.	Mixed Juice.	Syrup.	Difference between First Mill Juice and Syrup.	Extraction.	Polarization of the Sugar.	Total Recovery.
1912	9	88·6	86·1	87·2	1·4	93·72	96·67	85·36
1913	9	88·9	86·4	87·6	1·3	94·79	96·55	87·30
1914	9	88·6	86·0	87·1	1·5	96·30	96·396	88·99
1915	10	88·0	85·3	86·7	1·3	97·27	96·396	89·61
1916	10	88·0	85·5	86·6	1·4	97·42	96·28	89·22
1917	10	88·2	85·4	87·0	1·2	97·60	96·47	89·65
1918	10	87·3	84·15	86·0	1·3	97·39	96·38	88·90
1919	10	87·7	84·7	86·0	1·7	97·72	96·25	89·91
1920	11	88·1	84·5	85·9	2·2	97·81	96·43	89·19
1921	11	87·1	83·6	84·9	2·2	97·94	96·68	88·49
1922	11	87·3	84·2	85·7	1·6	97·85	96·78	88·90

This tabulation shows there has been a consistent improvement in the average extraction of all the mills during these years, and that up to the last two or three years there has also been a definite increase in the total recovery. The increase in total recovery, or, more correctly, in boiling house recovery, is really due to an increased capacity of the boiling house, insuring proper equipment for handling the work in an inefficient manner. It is also due to more care and skill in operation.

It will be observed that there is some irregularity in the figures. This, however, may be accounted for in some years by the inclusion in the average of certain factories which previously had not been mentioned, a tendency to reduce the quality of work thus being introduced.

By plotting a graph for total recovery, boiling house recovery, and purity of syrup during the years 1912 to 1922, it will be noted that in the first four years there was a decided improvement in the extraction, boiling house recovery, and total recovery, in spite of the fact that the purity of the syrup was gradually decreasing. Later, there was a small but definite increase in the extraction; and now while the total recovery continues to be good it follows the fluctuations of the purity of the syrup.

Mr. GIACOMETTI, of Olaa Sugar Co., wrote that there was nothing in his records to indicate that much improvement had been made in boiling house recovery. The mills are better equipped; and, as the result of a more generous pan and centrifugal capacity, superior work is the result.

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[1] Report of the Boiling House Section of the Committee on Manufacture of Sugar, Hawaiian Sugar Planters' Association, September, 1923, here abridged.

Mr. Leslie W. Wishard, Manager, Union Mill Co., Kohala, Hawaii, said that his boiling house recovery has shown a consistent improvement during the last four years, as indicated by the following figures:—

Year.	Boiling House Losses.	First Mill Purity.	Actual Boiling House Recovery.
1920	19·58	86·8	80·42
1921	18·86	84·2	81·14
1922	14·71	85·9	85·29
1923	11·46	85·9	88·54

Evidently this marked improvement in recovery is not due to higher purities of the initial juices, nor to different methods of boiling; but is unquestionably due to a rearrangement of the boiling house equipment with the single aim of insuring a better control of the various processes. But, what is most important, it is also to be attributed to a closer supervision on the part of the boiling house staff. Very little additional equipment has been added during the period.

Mr. H. Wolters, Manager of the Makee Sugar Co., Kealia, Kauai, reported an increase in recovery, which he attributed to more efficient handling of the low grades, due to longer drying time in the centrifugals and to less water added to the low grade massecuites. Taking more molasses into the No. 1 sugar strikes, and thus lowering the purity of the low grade massecuites from 55 and 56 to 50 and 51 purity, has likewise helped considerably.

Mr. C. E. S. Burns, Manager of the Pioneer Mill Co., Ltd., Lahaina, Maui, wrote that he had continued the practice of liming the juice to phenolphthalein alkalinity with beneficial results, the following being a comparison with the results obtained during one week when he returned to litmus neutrality:—

	Lbs. Lime per ton of Cane.	Mud per cent. Cane.	Pol'n. of Mud.	Mixed Juice to Syrup.
Neutrality week	1·113	2·86	1·65	0·53
Adjoining weeks	1·294	3·16	1·39	0·99
Average for crop	1·225	3·14	1·33	1·02

No difference was noted in the time of drying, or in the purity of the waste molasses from the low grade strikes boiled during the week. An increase in recovery was noticed, but this was more than offset by the lowered purity of our juices:—

	Purity of Syrup.	Actual Recovery.	Theoretical Recovery.	Actual, per cent. Theoretical.
1919-1923	85·61	91·67	91·48	100·20
1914-1918	87·12	92·69	92·69	100·00
1909-1913	89·22	93·57	94·30	99·23

Mr. Geo. F. Renton, Jr., Manager Ewa Plantation Co., remarked that from his compilation of factory data for the years 1916 to 1923 no steady increase in in boiling house recovery can be noted.

A slight improvement is indicated for the period 1920-1923 over the previous four-yearly period, but it seems probable that this is due, in part at least, to the lower extraction at the mill during these years. Although no pronounced higher recovery is noticed from year to year, the work in the boiling house has nevertheless improved, as at least as good results have been achieved with much less handling of material and with less labour. Massecuite storage tanks were used much less during the last four years than previously, which is attributed to greater skill in sugar boiling and the handling of low grades. These methods of boiling have not changed radically.

The Effect of Filtration with Vegetable Carbons and "Filter-cel" (Kieselguhr) on the Number of Micro-organisms in Cane Juices and on their Subsequent Rate of Development.

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The use of chemically inert adsorbents for the clarification of cane juices and syrups has been very extensively investigated chemically from both the laboratory and factory standpoint during the past seven or eight years. It would seem, in fact, that neither chemical nor physical phases could have been overlooked by the large number of investigators who have occupied themselves with this subject, including the names of SCHNELLER,[1] ZERBAN,[2] COATES,[3] BREWSTER,[4] BRADLEY,[5] OGILVIE,[6] SAUER,[7] DUNSTONE,[8] HUDSON,[9] ZELNICZEK,[10] DEDEK,[11] TILLERY,[12] SANDMANN,[13] AVOT,[14] HORNE,[15] CHANEY,[16] and others. Indeed to mention the names of the chemists who have at one time or another studied the action of these substances upon sugar products is almost equivalent to publishing a roster of the sugar chemists of the world. But bacteriologists have apparently been slow to appreciate the importance of this field of investigation, and the literature on this phase of the action of these new clarifying agents is extremely fragmentary. KOPELOFF[17] in 1920 reported observations on the comparative numbers of micro-organisms in cane juices, clarified with "Norit" and "Filter-cel" in actual factory practice, and CALVERT and KNIGHT[18] have more recently published results of their interesting investigations on the effect of "Filter-cel" filtration upon the micro-organisms in sugar solutions. These investigations of the bacteriological effects of filtration of cane juices, and sugar solutions with chemically inert adsorbents, have, however, been confined either to the observation of factory practices, or to the specific action of only one of these substances, as in the case of the more recent work referred to above. It is of considerable economic as well as of scientific importance to determine whether the clarification of cane juices by these substances yields products superior as regards their tendency to undergo decomposition, or their initial content of micro-organisms, compared with those obtained by the old methods of clarification. The current claims regarding the sterilizing effects of carbon filtration, and the unsusceptibility to fermentation which such treatment imparts to the products treated, are astonishing, and certainly warrant extensive investigation for confirmation and acceptance. One hears quite frequently that cane juices filtered with carbons are rendered entirely sterile, or that cane syrups made from carbon-treated juices will not ferment, or at least are comparatively unsusceptible to biochemical changes. Certainly there are many very important phases of this subject that need investigation; such, for example, as the rate of growth of micro-organisms in cane juices clarified by the various types of carbons and inert adsorbents, the rate of growth in syrups made from such juices, and the amounts of formaldehyde required to preserve carbon-treated juices as compared to ordinary raw juice. The purpose of the present investigation was to determine the precise bacteriological effects resulting from the filtration of cane juices with vegetable carbons and "Filter-cel," and thereby to confirm or disprove, as the case might be, some of the claims regarding the effect of these substances as they are ordinarily used in the sugar industry.

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[1] *La. Planter*, **69**, 156. [2] *La. Bulletins*, Nos. 161 and 173. [3] *J. Ind. Eng. Chem.*, 1922, **14**, 295.
[4] *J. Ind. Eng. Chem.*, 1922, **14**, 946. [5] *I.S.J.*, 1921, **23**, 25. [6] *I.S.J.*, 1922, **24**, 473–480.
[7] *I.S.J.*, **15**, 404; **16**, 566; **17**, 70; 129; **18**, 517; **20**, 24. [8] *La. Planter*, **68**, 254.
[9] *Chem. Abstracts*, 1922, **16**, 323. [10] *La. Planter*, **69**, 155. [11] *Listy Cukrovar.*, 1921, **39**, 383.
[12] *La. Planter*, 1921, **67**, 9. [13] *La. Planter*, 1922, **70**, 473. [14] *I.S.J.*, 1923, 196, 25.
[15] *J. Ind. Eng. Chem*, 1922, 14, 1134. [16] *La. Planter*, 1924, 72, 52. [17] *La. Planter*, 1920, **64**, 14-15.
[18] *Facts About Sugar*, 1923, **17**, 178.

PLAN OF THE EXPERIMENTS.

The experimental part of this investigation is divided into two parts, viz.: (1) A test of the comparative efficiency of various vegetable carbons and "Filter-cel" in removing micro-organisms from cane juices; (2) a test of the comparative rate of growth of micro-organisms in unfiltered and in carbon-filtered juices and syrups. In planning the details of the experiments included in the first division of this investigation, it is necessary to choose between hot and cold filtration. This places one somewhat in a dilemma, because the choice of the first, while conforming to actual factory practice, does not show the adsorbent effect of the substance uninfluenced by the bactericidal effect of the temperature itself. On the other hand, to choose the latter course is to place the clarificants at a much greater disadvantage as regards their adsorbent powers, than they are ever subjected to in actual practice. Both KOPELOFF and CALVERT and KNIGHT made their observations with hot filtration; but the writer adopted the former method, because it would, in his opinion, give a better indication of the relative adsorbent qualities of the substances for micro-organisms. If hot filtration is employed, it is essential that the time of filtration be constant in all of the experiments, otherwise the effect of the prolonged exposure to high temperatures would invariably tend to favour the slowest filtering carbons.

The general plan of the experiments was as follows: Weighed portions of "Filter-cel," "Darco," "Norit," and "Suchar," were introduced into Erlenmeyer flasks containing 200 cc. of distilled water, and sterilized in an autoclave at 15 lbs. pressure for 15 mins. The amount of these substances was equivalent in every case to 5 per cent. of the solids of the juice to be filtered. The filter flasks, with Buchner funnels, filter-paper, and stoppers, were sterilized in the autoclave with the carbons. The suspension of carbons and water was filtered while hot; and the juice to be tested was filtered through the paper coated with the carbons. In every case the filtrate was poured back into the funnel, even if it was slightly cloudy, but this seldom had to be done more than once. As soon as the requisite amount of juice had been filtered, the filtrate was immediately plated out, and a sample reserved for chemical analysis. The samples were plated out on a culture medium made from a cane juice filtered with "Filter-cel," to which 2 per cent. of agar-agar had been added. The plates were incubated for three days at a temperature of 34° C., and the colonies then counted. Of the various carbons tested, only "Norit" was given an acid treatment before using. This was in accordance with the instructions supplied by the "Norit" Company, which accompanied the sample of carbon donated for our purpose.

In the following table is given the data from five different experiments on the action of carbons upon the micro-organisms contained in cane juices.

In the summary of the above table we note that there does not seem to be much correlation between the increase in purity of the filtered juices and the percentage of micro-organisms removed by filtration. For example, "Suchar" gave the highest percentage of increase of purity, and the lowest in removal of micro-organisms. All of the substances left only from 0·6 to 0·31 per cent. of the number of micro-organisms originally present in the juice. It is interesting to note that the filtration of the raw juice through cotton-wool removed on an average about 75 per cent. of the micro-organisms. This is not suprising in view

Table 1.

Sample.	Brix.	Single Pol.	Sucrose, Clerget.	Purity.	No. Micro-Organisms.[1]	Increase in Purity.	Micro-Organisms remaining, per cent. Original.	Kind of Micro-Organism.
Raw juice	—	—	—	—	5200	—	—	Gum-forming yeast
"Filter-cel"	13·31	9·5	9·97	74·9	10·2	—	0·19	Gum-forming bacteria.
"Norit"	11·49	9·4	9·85	85·72	1·0	—	0·019	Yeast and mould
"Suchar"	12·14	9·3	9·53	78·50	7·8	—	0·15	Yeast and gum-forming bact.
"Darco"	12·14	9·3	9·61	79·00	15·6	—	0·30	Yeast and mould
Raw juice	13·82	6·6	7·58	54·84	5520	—	—	Gum-f'ing bact.
Filter cotton	—	—	—	—	2920	—	52·8	do.
"Filter-cel"	13·02	6·61	7·94	60·75	132	5·90	2·3	Chiefly yeast
"Darco"	9·03	4·8	5·57	61·68	87	6·84	1·3	do.
"Suchar"	10·19	5·0	5·88	57·60	94	2·76	1·7	do.
"Norit"	12·13	6·0	6·80	56·05	69·2	1·21	1·25	do.
Raw juice	14·69	6·16	7·49	50·90	600	—	—	
Raw juice filter cotton	—	—	—	—	640	—	106·6	
"Filter-cel"	13·09	5·0	6·54	49·90	0·200	—	0·03	
"Darco"	11·49	4·6	5·92	51·50	5·4	0·6	0·90	
"Norit"	11·49	4·6	5·76	50·13	1·2	—	0·20	
"Suchar"	11·49	4·6	5·92	51·50	6·4	0·6	1·06	
Raw juice	14·76	10·0	9·05	61·10	1000	—	—	Gum-f'ng bact.
Filter cotton	—	—	—	—	640	—	64·00	Mould
"Filter-cel"	12·85	7·4	7·84	61·00	28·80	—	0·28	
"Darco"	12·88	7·8	8·31	64·50	25·40	3·4	0·25	
"Norit"	12·48	7·8	8·23	65·90	3·00	4·8	0·3	
"Suchar"	11·58	7·8	8·31	71·70	26·60	10·6	0·266	
Raw juice	14·90	8·25	8·55	57·30	5000	—	—	
Raw juice filter cotton	—	—	—	—	1800	—	37·6	
"Filter-cel"	8·90	5·25	5·29	59·00	7400	1·7	0·148	
"Darco"	11·65	6·85	6·99	60·00	8·4	2·7	0·188	
"Norit"	10·76	6·15	6·46	60·00	15·4	2·7	0·308	
"Suchar"	10·58	6·0	6·35	60·00	4·4	2·7	0·08	

SUMMARY.

Sample.	Average Increase in Purity.	Average Micro. removed, per cent.
Filter cotton	—	75·1
"Filter-cel"	2·7	99·69
"Darco"	3·99	99·54
"Norit"	1·70	99·45
"Suchar"	4·83	99·40

Sample.	Brix.	Single Pol.	Sucrose, Clerget.	Purity.	No. Micro Organisms.	Increase in Purity.	Micro-remaining, per cent. Original.
Raw juice	15·5	9·75	9·92	62·8	1180	—	—
Filter cotton	—	—	—	—	960	—	81·3
"Filter-cel"	15·02	9·8	9·96	66·3	0·200	3·5	0·016
"Darco"	11·29	7·9	7·52	67·4	0·400	4·6	0·033
"Norit"	13·47	9·4	8·65	64·2	7·6	1·4	0·64
"Suchar"	9·99	6·8	6·34	68·4	4·8	5·6	0·40

N.B —In these Tables it should be noted that the number of micro-organisms is given in thousands per c.c.

of the fact that the initial infection of juice from sound cane comes from the dirt that is conveyed to it by the rind and the leaves of the plant. From an industrial standpoint, the removal of 75 per cent. of the micro-organisms contained in the raw juice is well worth considering, especially since it appears so easily accomplished, being the result of the mere removal of mechanically suspended particles. This would indicate that the utilization of efficient juice strainers might have a value quite distinct from the advantages that are derived from the elimination of *bagacillo* and other physical impurities. It is of interest in this connexion to note the results obtained in Hawaii [1] on the deterioration of cane under different conditions.

It was found in those experiments that the infection of a juice with cush-cush resulted in a decrease of over six per cent. in purity over the uninfected juice, within a period of four hours. To quote from the interesting report above referred to, we have these significant statements:

> "The effect of the infection by sour cush-cush or fermented juice may not be strong enough to destroy sucrose in the inoculated juice during the short time of half-an-hour, yet the quantity of badly deteriorated material accumulating in the old apron conveyors, and in the crevices and corners of some mills, which material from time to time is washed into the juice, is enough to lower appreciably the purity of the mixed juice below what it should be. This we shall try to demonstrate from figures taken from Ewa. During fifteen weeks grinding with a nine-roller mill, with reduced chances for souring, the average differences between crusher and mixed juice were :
>
> | | |
> |---|---|
> | Mondays .. .. | 2·75 |
> | Tuesdays .. .. | 2·75 |
>
> But during 20 weeks following grinding with 18 mills these were :
>
> | | |
> |---|---|
> | Mondays .. .. | 4·16 |
> | Tuesdays .. .. | 4·53 |
>
> This result caused us to wash down the mill whenever we had a chance to do so, and on quite a number of days we stopped the mill purposely to clean it out with hot water On such days the crusher and mixed juice difference was 2·07 ; on other days it was 3·07, which was the average of 25 samples.
>
> At Ewa, conditions have been severer than in any other places, the protracted grinding season of late years having prevented the mills being brought up-to-date in regard to cleanliness. That a step has been made in the right direction by the installation of two Meinecke conveyors and more self-cleaning juice trays, is shown by the fall of the difference between crusher and mixed juice during the time that our mill was thus equipped during the past season. While previously the difference was 4·78 (1921), 4·28 (1920), 3·65 (1919), it is now 2·80 with the same 18-roller mill and about the same extraction."

Glancing down the last column to the right of Table I, it will be noted that the types of micro-organisms in the filtered juices were, as as rule, quite different from those in the original sample. That is to say, the adsorbents had apparently acted in a selective capacity towards the gum-forming bacteria, and had removed these to a greater extent than the other groups of micro-organisms. This was true almost without an exception, and in every recorded instance yeast and mould predominated in the filtered samples. In view of the fact that it is the gum-forming bacteria that gives most trouble in juice clarification, the apparent selective action of the adsorbents tested in these experiments furnishes a strong argument in behalf of their more general use. On the whole, the results of our experiments do not differ materially from those observed by KOPELOFF, and we shall have occasion later to compare our data with those of CALVERT and KNIGHT.

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[1] *I.S.J.*, 1923, 25, 474, 478.

A Test of the Comparative Rate of Development of Micro-organisms in Carbon-treated and in Untreated Cane Juices.

The plan of the experiments that were carried out in connexion with this portion of the investigation was as follows: The samples of juice were treated first with 1 per cent. of "Filter-Cel" (on weight of juice), and then with the same amount of the various carbons to be tested. One sample of the original juice was kept for comparison, and also a sample of the juice filtered with "Filter-Cel" alone. Two hundred c.c. portions of these samples were introduced into Erlenmeyer flasks, which were plugged with cotton-wool and sterilized for 30 minutes on three successive days. When ready for use, they were inoculated with 1 c.c. of a freshly extracted raw juice, a sample of the same juice being kept for comparative observation. The flasks were then left at room temperature (20°C.) which dropped to 14 on the following morning (12 hours later). The results of a 48-hour storage period on the carbon treated juices are given in Table II.

Table II.

	Raw Juice.	Ster. Raw Juice Increase.	"Filter cel."	"Darco."	"Norit."	"Suchar."
Original No. micro-organisms[1]	1840	10·2	8·6	9·4	10·4	9·0
Original Brix	15·6	12·91	—	13·24	14·14	13·31
Original sucrose	12·23	7·29	—	7·84	7·97	8·00
Original reducing sugars	2·27	2·87	—	3·03	2·94	2·77
Original purity	78·39	56·9	—	59·87	56·36	59·22
No. micro-organisms after four hours	1840	11·0	10·8	6·4	10·6	12·6
Brix	15·51	—	—	—	—	—
Sucrose	12·55	—	—	—	—	—
Reducing sugars	2·19	—	—	—	—	—
Purity	81·56	—	—	—	—	—
No. micro-organisms after seven hours	840	8·2	11·4	8·4	7·00	6·2
Brix	15·27	—	—	—	—	—
Sucrose, Clerget	12·80	—	—	—	—	—
Reducing sugars	2·10	—	—	—	—	—
Purity	83·82	—	—	—	—	—
No. micro-organisms after 24 hours	168·0	345 4	173·4	234·6	144 0	196·0
Brix	15·11	12·85	15·22	13·11	14·04	13·61
Sucrose, Clerget	11·41	7·57	8·60	7·85	7·88	8·06
Reducing sugars	1·52	2·73	2·94	2·60	2·94	2·70
Purity	75·51	58·9	56·57	59·87	56·12	59·22
No. micro-organisms after 48 hours	312	16	—	11	12	8600
Brix	13·10	12·85	—	13·11	14·04	13·61
Sucrose	10·08	8·21	—	7·66	8·69	7·37
Reducing sugars	0·33	2·56	—	2·79	3·15	3·29
Purity	76·00	63·9	—	58·4	61·8	54·1

Temperature of Storage 20–21°, next Morning 14°.

	Raw Juice.	Increase Raw Juice.	"Filter-cel."	"Darco."	"Norit."	"Suchar."
Decrease purity	2·39	+ 7·0	—	1·4	+ 5·5	5·12
Ratio increase, micro-organisms	1 : 169	1 : 1568	1 : 202 24 hrs.	1 : 1178	1 : 1153	1 : 955

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[1] In thousands per c.c.

A study of that table shows that apparently no deterioration has occurred in any of the samples except in that of the original raw juice within the period of 24 hours. Through the first two periods there is an apparent increase in purity in the raw juice, presumably due to the effect of gum levan on the Clerget method of double polarization.[1] While the analytical data would indicate that no destructive changes had taken place within 7 hours, the increase in the viscosity of the juice was indicated by its slow rate of filtration, and from the standpoint of manufacturing its original value was evidently impaired. It will be noted that no material change had taken place in the reducing sugars of the raw juice during the 7-hour period of storage. This is also indicative of levan fermentation, since only sucrose is utilized for that purpose. This observation that the reducing sugars remain stationary for a considerable interval of time in stored cane juice has also been commented upon by ORTH[2] in the report from Hawaii, previously referred to. At the end of the 24-hour period the raw juice has deteriorated in purity, and the reducing sugars have likewise decreased. The inoculated raw juice has undergone changes that give it an apparent increase in purity; the increase in its micro-organisms has been greater than in any of the filtered juices, thus indicating the retarding effect of the elimination of nutrients in the process of clarification. It should be explained in this connexion that the original juice here is an entirely different sample from the sterile raw juice, so no comparisons can be drawn as to their respective compositions. The sterile raw juice represents, however, the same juice as that on which the carbons were used, and the original juice is the sample from which the filtered juices were inoculated. At the end of the 48-hour period, the raw juice had apparently increased in purity over that of the preceding period, while its reducing sugars had been almost entirely destroyed. The ratio of increase of micro-organisms was largest in the inoculated raw juice, and lowest in the "Suchar" filtered juice. We leave out of consideration, of course, the ratio of increase in the original juice, where the numbers at the beginning are too large to admit of the same ratio of increase, as is possible in the inoculated samples. The apparent increase in purity in some cases and decrease in others, merely indicates a difference in the type of micro-organisms developing in the respective samples. This is of interest, however, since it indicates that the selective action of the carbons tended to alter to a different degree the suitableness of the juice for the development of the different groups of micro-organisms. All of the inoculated samples, it should be remembered, received the same inoculation, so that their content of micro-organisms at the beginning must have been quantitatively and qualitatively identical.

There is one phase of the rate of development of the micro-organisms in the original juice that should be mentioned in this connexion. A glance at the columns opposite "Number of Micro-organisms" will show that there is a large decrease in the numbers of micro-organisms in the raw juice after 7 hours. There are decreases at this same period with many of the filtered juices. BROWNE[3] has referred to this germicidal action of fresh cane juice, and some years ago published some interesting results of his experiments on the subject. That the carbon-treated juices should have also shown this property is not surprising in view of the fact that all enzymes would not have been removed by the amount of carbon used, nor would the heat of sterilization which was under 100°C. have necessarily entirely inactivated them. In order to have the temperature of storage more nearly equivalent to that of the average conditions during the grinding season in Louisiana, the juices in the next experiment were placed in a low tem-

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[1] *J. Bacteriology*, Vol. 3, No. 5. [2] *Loc. cit.* [3] *J. Amer. Chem. Soc*, Vol. 28, 1906.

Table III.

GROWTH OF MICRO-ORGANISMS IN CARBON-TREATED JUICE AT LOW TEMPERATURES (16°C.).

	Original Raw Juice.	Ster. Raw Juice Inoc.	"Filter-cel."	"Darco."	"Norit."	"Suchar."
Original No. micro-organisms[1]	133·2	1·4	0·600	12·4	18·0	0·200
Brix	11·28	12·33	15·08	14·08	14·58	14·28
Sucrose, Clerget	8·22	6·71	10·83	10·72	10·85	10·43
Reducing sugars	—	—	—	—	—	—
Purity	70·2	54·4	71·8	76·1	74·4	73·03
No. micro-organisms after 36 hours	7,200	15,320	10,400	13,600	10,680	20,000
Brix	8·92	13·17	15·67	14·87	15·57	14·67
Sucrose, Clerget	1·79	1·52	8·71	8·77	9·46	9·42
Purity	20·0	11·5	55·00	55·60	60·70	64·20
No. micro-organisms after 60 hours	416,000	248,000	148,000	22,600	8,960	12,400
Brix	5·0	6·4	15·4	14·8	15·2	14·5
Sucrose, Clerget	2·17	3·52	10·48	9·16	10·12	10·42
Purity	Gummy	Gummy	Gummy	Gummy	—	—
Original No. micro-organisms	1440	5·2	6·4	5·6	9·6	9 2
After three hours	1000	—	—	—	—	—
Brix	—	14·18	14·18	13·53	13·60	13·30
Sucrose	—	9·01	9·48	9·30	9·46	8·71
Purity	—	63·5	66·8	66·5	69·5	65·4
Average	—	1·7	1·9	1·5	1·6	—
No. micro-organisms after 24 hours	240,000	7,640	56·2	69·3	5·4	66·2
Brix	—	14·18	14·18	13·53	13·60	13·30
Sucrose	—	8·64	8·51	8·54	8·70	8·71
Purity	—	60·9	60·0	63·1	63·9	65·4
Average	—	—	—	—	—	—
No. micro-organisms after 48 hours	—	248	17,200	12,400	8,800	7,480
Brix	—	14·18	13·53	12·88	13·30	13·30
Sucrose	—	4·60	6·81	4·49	4·96	7·42
Purity	—	32·4	53·3	34·8	37·29	45·9
Average	—	6·00	4·8	3·4	3·5	3·4

SUMMARY OF TABLE III.

Sample.		24-hour.	36-hour.	48-hour.	60-hour.
Ster. Inoc.	Decr. purity	2·6	42·9	28·5	—
	Inc. micro	1 : 1468	1 : 10,942	1 : 47,692	1 : 47,692
"Filter-cel"	Decr. purity	6·8	16·8	13·5	—
	Inc. micro	1 : 8·7	1 : 17,333	1 : 2687	1 : 23,125
"Darco"	Decr. purity	3·4	20·5	31·7	—
	Inc. micro	1 : 1·2	1 : 1096	1 : 2214	1 : 1822
"Norit"	Decr. purity	5·6	13·7	32·21	—
	Inc. micro	1 : 5·6	1 : 593	1 : 916	1 : 497
"Suchar"	Decr. purity	—	8·83	19·5	—
	Inc. micro	1 : 71	1 : 100,000	1 : 813	1 : 62,000

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[1] In thousands per c.c.

perature incubator, and kept at a temperature of 16°C. The mean average temperatures in Louisiana[1] over a period of fourteen years, for the months of October, November and December, were as follows:

October..	20·8° C.
November	16·6° C.
December..	14·5° C.

The temperature selected for these experiments may be seen to be fairly representative of the mean temperatures prevailing in Louisiana during the grinding season. The results of this experiment are given in Table III.

The data in this table are obtained from two different experiments and comparisons should be confined to the data within each experiment, that is the 24 and 48-hour period in one case, and the 36 and 60-hour period in the other. A study of the summary of the table shows that while the number of micro-organisms that had developed in the 24-hour period was less than in the previous experiment, the deterioration in the latter experiment was much greater. It is significant also that there seemed to be a greater tendency towards viscous fermentation in the juices stored at lower temperatures. This is in accord with the results of previous investigations[2] of collateral phases of this subject. In the second portion of this table we find an initial decrease in the number of micro-organisms in the raw juice, to which we have called attention in the discussion of the results of the previous experiment. There is nothing in the results given in the above table that would indicate any consistent benefits resulting from carbon filtration, as regards the decreased susceptibility of juices so treated, except as this advantage is reflected in the increase of acidity of the various samples. Here we find that the increase in acidity in the raw juice was almost twice as great as in the filtered samples.

(*To be continued.*)

A slide rule for the calculation of apparent purity carried out in the routine work of the sugar factory and refinery has been devised by H. J. **Bastone**.[3] It is of the 20-in. Mannheim type, having two scales, one for "polarity" and purity and the other based on the logs of the Brix factors. It is claimed to eliminate charts and factor tables, and to give results of a sufficient degree of accuracy in a very short time.

Reserves of petroleum oil for the production of fuel for internal combustion engines are considered to be limited; but the supply of alcohol will of course be inexhaustible so long as saccharine and starchy plants can be cultivated. Another possibly unfailing source of motor fuel is vegetable oil, which as A. **Mailhe**, M. **Sato**, and others, have shown can be converted to products closely resembling mineral oils. Thus by catalytic hydrogenation it is possible to split up colza oil into substances closely resembling fuel oil, lubricating oil or grease, and into other products of petroleum distillation.[4]

J. M. **de Mendivil y Valesco**[5] read a paper before the 11th International Congress of Agriculture describing methods of producing beet seed in Spain, by which strains averaging about 20 per cent. of sugar are produced. He denies the existence of the so-called inverse correlation between the weight of a beetroot and its sugar content, believing that it may be possible for the breeder to obtain strains of high sugar content and of a heavy weight as well. A comment on this states[6] that if beet seed selectors are able to raise the weight of the root without impairing its sugar content, then the agricultural possibilities are enormous. At present the record for richness and size is held by a 1923 Colorado beet weighing a little over 23 lbs. and containing 18 per cent. of sugar. If this strain were fixed, and assuming 10,000 such roots to the acre, with 15 per cent. recovery, this would give 17 tons of sugar per acre.

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[1] *I.S.J.*, 1915, 17, 275, 280. [2] *I.S.J.*, 1915, 17, 275, 280.
[3] *Industrial and Engineering Chemistry*, 1924, 16, No. 2, 175.
[4] *Tropical Agriculture*, 1924, 1, No. 2, 21.
[5] *Suppl. Circ. hebdom.*, No. 1814. [6] *Facts about Sugar*, 1924, 18, No. 5, 111.

Reports of the Chemical Section of the Association of the Hawaiian Sugar Technologists.[1]

Compiled by S. S. PECK.[2]

CANE BORER INJURY.

Several very interesting reports have been received on a variety of topics, the salient features of which are here presented.

RAYMOND ELLIOTT contributed a very interesting report on a very thorough investigation on the cane borer injury, conducted by him at Paauhau. Representative quantities of cane were cut from whole fields, the sticks then divided into groups according to whether they were sound, borer-infected, or with or without rat injury. He kept a count of the rat-eaten cane as well, in order to ascertain whether there was any connexion between rat-eaten cane and the borer injury. An average of 28 per cent. infestation by borer on the quantity of cane examined of all varieties was found, the infestation of the different varieties being as follows: Yellow Caledonia, 34 per cent., H 109, 29 per cent., D 1135, 9 per cent. Two per cent. overall was found to be both rat-eaten, and borer-injured. To emphasize the damage wrought by these pests, he calls attention to the fact that the quality ratio has increased on an average from 7·78 to 12·85 for all the experiments conducted on Caledonia and H 109 canes. Computing the loss in dollars and cents, it amounts to 1·9 per cent. on sugar per acre, or 17·3 per cent. in actual money.

INFLUENCE OF LIME ON BOILING-HOUSE PURITIES.

F. D. **BOLTE** reported on this subject and his data are all the more valuable because they represent actual working conditions throughout a number of years. Tabulated results show the following interesting facts: The lime used per ton cane was increased from 1·07 lbs. during 1915-1921 inclusive, to 1·26 lbs. in 1922-23. Correspondingly, the increase in purity rose from 0·58 to 1·75 ; but, on the other hand, the drop in purity of No. 2 massecuite to No. 2 molasses, and from No. 3 massecuite to No. 3 molasses decreased from 12·8 to 8·7 and 10·2 to 8·5 respectively, giving a higher gravity purity waste molasses for 1922-23 than previously, i.e. 42·3 against 40·5.° The amount of lime used did not seem to affect the drop of purity in the first boilings. Tables were presented showing the relationship between the quantity of lime used and the corresponding change in purity from year to year, also the averages for the periods together with the final molasses figures. The boiling-house recovery and efficiency figures are also given, showing 2·49 per cent. increase in recovery for 1° increase in purity, and 3·37 per cent. for 2° increase, figuring on the same gravity purity molasses. In his recapitulation, Mr. **BOLTE** strikes the keynote of his report when he says that, while it is better to use too much lime than too little, it is better to use just the right quantity. The correct amount appears to be about 1·20 lbs. per ton of cane, varying with the acidity of the juice, and the kind of lime used, giving a slight alkalinity to red litmus paper on hot clarified juice, corresponding to 0·15 per cent. acidity against phenol and N/28 KOH solution, using 1·5 c.c. of it to titrate 10° c.c. of the juice.

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[1] Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923 ; here abridged.

[2] Acting Chairman, Chemical Section.

CLARIFICATION AND "FILTRABILITY."

H. F. **HADFIELD** contributed a report on clarification. After defining the term, and describing the process with its attendant chemical and physical changes, he emphasized the importance of correct liming, dwelling on the methods in use for determining acidity and alkalinity as a guidance to liming. The great importance of heating the limed juice to the right temperature and for the right length of time was mentioned, calling attention to the fact that there is apt to be a variation in the precipitation and the subsequent rate of settling. The character of the impurities, and their relation to the sugar in solution was also pointed out, with reference to the viscosity of the massecuites and molasses.

The much discussed topic as to the poor "filtrability" of Hawaiian sugars was discussed. It seems to be the general opinion that this is directly due to neglect in clarification, and the presence of suspended solids in the juice. The writer quotes the opinion of **PECK**, **WELLE**, and **PRINSEN GEERLIGS** on the subject, the essence of which is that finely divided solid matters held in suspension, when heated with lime, will change into a hydrolysed gummy matter, enter the solution, and go through the whole process. In each of the quotations, emphasis is laid on the importance of the removal of these suspended particles from the juice by screening.

Tests on 96° sugars show 0·06 to 0·005 per cent. suspended matter. It was surprising to find that practically the same quantity of suspended matter was found in plantation white sugars polarizing 98°-99°. Experiments show that raw sugar contains suspended particles not only in the adhering molasses, but also within the crystal itself. This seems to confirm the theory that sugar from a supersaturated solution of dirty syrup is apt to crystallize around a minute particle of fibre or suspended matter, and build up the crystal around it.

In screening the clarified juice or syrup, one should not lose sight of the fact that the wear on the screen, due to both mechanical causes and the corrosive action of the juice is great, and it has been found that greater amounts of particles than usual were getting into the sugar, because the perforations of the screen were worn to three times the original size. The usual 100 × 100 mesh screen apparently will not keep out the very fine particles of fibre; and to partly overcome this difficulty a 200 × 200 mesh screen will be of great help. This 200 × 200 screen is apt to get clogged up if it is used alone, but in conjunction with the 100 × 100 screen, or rather supplementing it, it should keep clear.

Mr. **HADFIELD**, quoting from Mr. **WELLE**, finds that the experience in the refineries in regard to this matter is the same as in our own factories, i.e., the suspended particles remain in the sugar after purging the sugar with affination syrup. On being melted, the crystals liberate the occluded particles, the whole forming a brown, dirty-looking liquid. These melts are then mixed with kieselguhr, and filtered through presses under pressure. It is at this point that the trouble is experienced, because with most Hawaiian sugars it takes three to four times more kieselguhr to keep the rate of filtration within the allowable time limit than with foreign sugars. Strange as it may seem, the soluble non-sugars remain practically the same before and after filtration. Press juice contains no suspended particles. This suggests that filtering the whole clarified juice through filter presses may solve the difficulty. But the question arises here as to whether this is within the scope of our factory policy or not.

A questionnaire sent out to various members of the Association brought out the following points:

Strainers which are being used at the mills vary in size from 90 to 100 mesh, and the mixed juice contains between 0·12 and 0·68 per cent. of suspended particles. With clarified juice 50 and 100 mesh screens are used, and the per cent. suspended matter in the commercial sugar is found to be between 0·07 and 0·005. Nobody has tried 200×200 screens. Those who screen the cold mixed juice through a 100 mesh, find the mud slimy, but this difficulty has been largely overcome by overliming the mud.

Several factories add lime to the mud, the press-juice being returned either to the mixed juice or clarified juice. All agree that at 190° F. the juices settle poorly, and at 240° they foam in the settlers and take longer to settle. Also that the slow drying of low grades was mostly due to poor clarification.

Replies indicate that no relationship between season and quality of low grade sugar was found. Mr. KING at Koloa found a consistent relation between the clarity of juice and its phosphoric acid content, but no relation in the rate of settling. Lower fields contained more phosphoric acid than did upper ones. Phosphoric acid variables in different varieties of cane affected the clarification differently.

BLANK BOILING.

The data and information contributed on Blank Boiling will no doubt be very valuable to those practising this method of working. The salient points of the answers sent in to the questionnaire on this subject, are given below:

The only treatment the molasses receives before string-proof boiling is steaming with the object of dissolving the fine grain which might be present and which otherwise would cause trouble in the subsequent purging. Molasses used in blank boiling should be reduced to 51-56 ° purity, with which initial purity two boilings will be required to obtain a satisfactory final molasses of say 38 ° gravity purity, the last boiling to start with at least 40-44 °.

Answers sent in seem to indicate that there is no advantage in boiling back molasses under 40° purity; the drying becomes slower, the yield smaller, and besides, it becomes a question of storage tanks and centrifugal capacity. As to the density to which low grades should be boiled, the limits of concentration as indicated by the answers are 90 to 96, depending on local conditions. With a decreasing purity of the last massecuite, an increasing density is desirable to obtain a goodly crop of crystals. In regard to the temperature at which the low grade boilings should take place, this ranges between 138 and 155° F., with a corresponding vacuum. In almost every case, the massecuite is discharged at the temperature at which it was boiled.

Only a very few members had experience with the brasmoscope as an aid to boiling, though without doubt it is a valuable instrument. Mr. MARCALLINO calls attention to Bulletin No. 20, of the H. S. P. A. Experiment Station, in which NOËL DEERR described this instrument. None of the factories practising blank boiling use recording vacuum and temperature gauges, though their value is universally recognised. No one has reported any experience with the refractometer.

Opinion is divided regarding the rate of cooling; but most seem to agree that speeding up the cooling tends to produce false and small grain. The average temperature at which the massecuite is sent to the mixer is about 86° F., some reporting as low as 77°, some as high as 104°. How many days after boiling is this temperature reached? In the case of No. 2 massecuite this is about 3-10 days, in No. 3 about 6-7 weeks, and in No. 4 about three months. Opinion differs as to whether crystallization is complete at the above-mentioned temperature (86° F.), some stating that the crystals will keep on growing thereafter.

Replies indicate that in small or flat iron containers the cooling and crystallization proceeds more rapidly than in large or wooden tanks. All members contributing, recognize the disadvantage of discharging successive strikes into the same tanks; the result is uneven grain, and of course the rate of cooling is slower. All agree that each strike should be dried separately. The practice of partially cooling each strike in separate tanks, say for one week, and then pumping it into larger tanks for further crystallization, is advantageous from the grain standpoint, according to SPRECKELS, BOLTE, and MARCALLINO.

Opinion divides as to the harmful effect of slow discharging of the massecuite from the pan. Some believe that no grain forms in a string-proof strike for the first few hours at least, others find that if the massecuite chills, false grain forms.

Foaming is caused in most cases by boiling at high temperatures, and sometimes on account of overliming. In order to prevent it, the boiling temperature should not exceed 155° F., though the exact limit is not known. If a massecuite has been unavoidably overheated during boiling, cooling it down in the pan before discharging is not always a remedy. Nothing definite can be said regarding the drying qualities of a foamed-over massecuite.

When boiling string-proof, the size and character of the resulting grain may be controlled to a certain extent by regulating the density; a heavy strike as a rule will yield a thicker crop of crystals, and a correspondingly lower molasses. A better exhausted molasses can be gained from fine grained than from coarse grained massecuite.

As a general rule, low grade massecuites which dry slowly yield a lower purity waste molasses, providing the slow drying was not caused by mixed or false grain. In the latter case, grain escaping through the screen will make for higher molasses. With equal purities, and grains of a similar size and character, that massecuite which is more concentrated will dry slower and will yield the better exhausted molasses.

Opinions differ as to the length of time for complete crystallization, and it depends largely upon individual equipment. The appearance of grain in the pan before striking, either by accident or by intention, ought to be avoided in low grade strikes to be cooled at rest.

Actual loss due to inversion during storage of massecuite is reported by two members, though it is noted that it is extremely difficult to obtain a representative sample from a large tank of massecuite at the time of drying, for the reason that the sugar tends to settle to the bottom while the top is foamy.

In answer to the question of the causes of slow drying the members suggest the following:—High density, high viscosity, excessive small grain, low purity, foamy massecuite, too much lime, too much massecuite. To aid drying, the following special practices are mentioned:—Reducing the density with water before drying; adding hot molasses before pumping the massecuite to the mixer; steaming it a little; and using a small amount of water in drying. When a refractory low grade massecuite is encountered, its drying qualities may be improved somewhat by allowing it further time to age.

The available square feet of screen surface per ton cane per hour for string-proof massecuites varies from 2·6 as the lowest to 7·86 as the highest, a wide variation.

Opinions differ as to whether there is any advantage of boiling to say 95°, and then diluting to 92°, as compared with boiling to 92° and not diluting. Of course, it is known that in the case of heavily concentrated massecuites, the water added will first be taken up by the mother-liquor for the reformation of the hydrated combinations of sugars and salts.

The following are the chief causes of a high waste molasses purity:—High purity mother-liquor, insufficient concentration, much small grain lost in drying of water for dilution, low-glucose ratio, poor screens, too much lime used, high glucose-ash ratio, unripe cane, insufficient centrifugal capacity, and poor arrangement of low grade tanks.

Recent Experience on Grooving Mill Rollers.[1]

Letters and questions were recently addressed to mill engineers in the Territory of Hawaii, and the following is a summary of some of the replies received:—

J. W. Carmichael, of Hawaiian Sugar Co., remarked that he believed in coarse grooving for the 1st and 2nd mills, and fine grooving for the 3rd and 4th mills, say 7 grooves to the inch. This arrangement has worked satisfactorily both in extraction, moisture, and a closer setting of rollers. The juice grooves of feed and back rollers should be straddled. In other words, the first groove on the feed roller would be 2 in. from the end, while the first groove on the back roller would be 3 in. from the end, with the following grooves spaced 2 in. apart.

R. E. Hughes, of Puunene Mill, wrote:—To establish some sort of a standard here, in both the Messchaert and surface grooving of rollers, the grooving now in use was decided upon several years ago, after considerable experimental work had been done to determine the best to suit our conditions. Our standard was arrived at gradually, and completed early in the year 1918. Since that time we have made no changes in the grooving, following as closely as possible our standard, which is as follows, and relates to mills operating with Searby shredders.

First Mills.—All first mill rollers are grooved to mesh, pitch of surface grooves ¾ in., feed roller Messchaert grooved 2¼ in. pitch. when new $\frac{9}{32}$ in. wide and 2¼ in, deep; no Messchaert groove scrapers are used on the returner bars; one set of scrapers at the bottom of the roller; no Messchaert grooves in the discharge rollers.

Second Mills.—Feed rollers are grooved ¾ in. pitch, Messchaert grooved 2¼ in. pitch, $\frac{9}{32}$ in. wide by 2¼ in. deep. One set of Messchaert scrapers is fitted under this roller; top roller surface grooved 8 to the inch; discharge rollers surface grooved 8 to the inch; Messchaert grooved 2 in. pitch, $\frac{9}{32}$ in, wide by 1¾ in. deep; one set of scrapers fitted to, and resting on lower blade of the Ramsay scraper, with a second set below the roller.

Third Mills.—Feed and top rollers grooved same as second mill. Discharge roller surface grooved 8 to the inch. Messchaert grooved 4 in. pitch, $\frac{9}{32}$ in. wide and 1¾ in. deep. Scrapers arranged same as second mill.

Fourth Mills.—Feed rollers grooved same as second mill. Top same as second mill. Discharge rollers surface grooved 8 to the inch. Messchaert grooves 2 in. pitch, $\frac{9}{32}$ in. wide, 1¾ in. deep. Two sets of Messchaert scrapers are fitted below the Ramsay scraper. All bagasse from these two sets is returned to the same mill in a dry condition by scroll conveyor.

Operating with this arrangement of grooving, we have had excellent results in extraction, low moisture in the final bagasse, and no difficulties with the feeding of the mills.

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[1] Report of the Committee on Grooving, presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923, here abridged.

Recent Experience on Grooving Mill Rollers.

To insure a maximum efficiency from the Messchaert grooves, they should be deep enough to allow for rapid and unobstructed drainage of the juice, yet not so deep as to weaken or shorten the life of the roller. If the bagasse is allowed to press down to the bottom of the groove, the mill might do as well without any Messchaert grooves. The same can be said of the groove when it is not scraped clean with each revolution of the rollers.

Our first mill rollers were grooved with the ¾ in. pitch groove soon after the installation of the Searby shredders. These take hold of the shredded cane and feed under all conditions or rates of grinding, and allow a very fine drainage way for the expressed juices.

Our last step in completing our standardization of the roller grooves consisted in the fitting up of all the mills with a feed roller of ¾ in. pitch. This change improved the feeding of the mills to such an extent that we were able to slow down the mills, thereby operating with a heavier blanket of cane and obtaining a higher extraction.

A ¾ in. pitch grooved roller, with Messchaert grooves of 2¼ in. pitch, when placed in the fourth mill of a 12-roller train as a feed roller, will tend to reduce the moisture in the final bagasse. The surface of these coarse grooved feed rollers improves as the grinding proceeds, the juice action tending to roughen up the surface, so that it becomes a mass of very small teeth. It has been our experience that wear and breakage with this groove are no greater than with any other.

J. L. Renton, of the Ewa Plantation Co., remarked: It is our intention to install the ¾ in. pitch feed steel roller in the second mill this off season for trial next crop. We are gradually changing the pitch of our top and back roller grooving from ⅜ in. to $\frac{3}{6}$ in. pitch. Before the advent of the Messchaert grooving, we believed the coarse grooving a help, both in feeding and juice extraction, but with Messchaert grooves we have gradually gone back to a finer grooving with equal results.

George Duncan, of Olaa Sugar Co., wrote: Previous to the campaign just finished, all our rollers were grooved 6 to the inch. At the end of last year it was decided to groove the feed rollers ¾ in. pitch, which grooving we used all this year. Very little, if any, advantage was observed from the use of them. They were very easily damaged by tramp iron, consequently the turner bar grooves were also damaged, which resulted in frequent breakage of the turner bar hook bolts. The juice grooves also wore away at the sides very quickly, this probably being caused by the bagasse becoming wedged tighter into them, helped by the wide ¾ in. groove at the top. This year we intend to change the pitch to ⅜ in. Several years ago we used this size grooving and very little trouble was experienced, even from iron getting into the mill. Large grooves, i.e., about ¾ in. pitch, are detrimental to the roller. The only advantage to be gained from them is heavy feeding, but this can be quite as easily obtained from grooves about ⅜ in. pitch. The life of the roller is considerably shortened by the large grooves, and every plantation is not in a position to purchase new ones every two or three years. Before recommending such coarse grooving, due consideration should be given to local conditions.

At Lihue mill, the writer wishes to say that a coarse grooved ¾ in. pitch feed roller was installed in the first mill in 1919, and this roller is still in operation, but as feed roller in the second mill, and at least a couple of years more service is expected from it. The rest of the rollers were fine grooved and we experienced considerable trouble in feeding, For the 1922 crop, we grooved the feed rollers of mills No. 2, 3 and 4 with ⅜ in. pitch grooves, and obtained better results in feeding. For the 1923 crop, we equipped the first mill with ¾ in. pitch grooved rollers, and the second and third mills with feed rollers of ¾ in. pitch grooving. As we had no suitable roller for coarse grooving, at that time, for the fourth mill, we retained the ⅝ in. pitch feed roller. All the other rollers in mills No. 2, 3 and 4 were grooved 7 to the inch. Our feed troubles ended in the mills equipped with coarse grooved rollers, but we continued having trouble in feeding the fourth mill. This year we are installing a ¾ in. pitch grooved feed roller in the fourth mill. Iron, in the shape of car links, pins, etc., finds its way into the mill, and is first noticed when passing through the shredder. An attempt is made to get it before it enters the rollers, but very seldom are we fortunate enough to do this before the first mill. The grooving on the first mill rollers was considerably damaged by iron, and we were obliged to re-groove the top roller once during the crop. A single set of juice groove scrapers is used on all the feed rollers, with no scrapers on the returner bar toes. The back rollers are equipped with juice groove scrapers resting on the lower Ramsay scraper, and one set below the roller, with the exception of the fourth mill, which has two sets of scrapers below the roller scraper.

American Commerce Reports.[1]

Costa Rica.

Most of the sugar produced is consumed in the country. Before the war no figures were given showing the exports; either there were none, or they were very insignificant. In 1914, however, Costa Rica began making small exports, which increased with the demand and rising price until the peak was reached in 1920, when prices were highest. Toward the end of 1922 exports of sugar began to increase again owing to favourable prices.

Although Costa Rica is not essentially a sugar-growing country, ordinarily producing only sufficient to meet the estimated needs of the country, there is a large acreage which could be planted to sugar for export. Unofficial estimates place the present production of sugar in Costa Rica at around 19,000,000 lbs. annually.

The following table shows estimated production in 1913 and exports for the past four years.

Sugar production, 1913, and exports, 1919–22.

Years.	Kilos.	Value.
Production, 1913	2,869,429	—
Exports:		
1919	2,043,815	$245,781
1920	5,107,251	1,320,350
1921	3,964,257	481,128
1922	2,608,678	201,706

Union of South Africa.

The production of sugar in the Union of South Africa in 1922, all of which is grown and milled in the Province of Natal, was estimated at 146,983 tons, as compared with 120,000 tons in 1921 and 190,000 tons in 1920. During the year 1921, 68,885 tons of sugar were exported, while in 1922, 36,000 tons found their way into the foreign markets, chiefly to Great Britain. At the same time the imports of this commodity in 1921 amounted to 12,642 tons, and in 1922 to 17,910 tons, practically all of which came from Portuguese East Africa.

During the whole year under review the wholesale and retail selling prices of sugar in South Africa were controlled by the Government—during the first half of the year under the Moratorium Act of 1914, and since July 1st, 1922, under a special act passed by

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Parliament. This latter act, however, expired on June 30th, 1923, and the Government relinquished its control over the price of this commodity.

At the request of the sugar planters and refiners, the South African Government made an exhaustive investigation of the industry and recommended that some measure of protection should be granted, particularly against the sugar produced in Portuguese East Africa. This sugar has been entering the Transvaal free of duty under the Mozambique Convention, but since this agreement expired on March 31st, 1923, the advantage that the Portuguese East African sugar enjoyed in South Africa, in competition with the domestic, lapsed, and there is no likelihood that it will be granted again in the future.

CUBA.

The Agrupacion Nacional de Destiladores has called upon the Cuban Government, through Secretary of Agriculture Betancourt, for immediate relief through measures designed to restrict exportation from Cuba of residual molasses in such a manner as to assure a sufficient supply for the distilling industry remaining in the country from year to year. Owing to the great local advance in the price of denatured alcohol for various purposes, it is quite possible that there will result a stimulation of the plans of the sugar companies for taking into their own hands the production of alcohol from their own molasses, which must ultimately be the logical solution of the present uncertainty of supplies.

CANADIAN SUGAR TRADE IN 1923.

The total imports of refined sugar into Canada in 1923 amounted to 17,039,979 lbs. as against only 2,654,178 lbs. in 1922; while the exports totalled 119,121,376 lbs. in 1923 compared with 316,651,937 lbs. in 1922. Of the 1923 total sugar imports, 73·7 per cent. came from the United States as against 38·3 per cent. of the 1922 total; and 7·5 per cent. was imported into Canada in 1923 from other parts of the British Empire, compared with 15·8 per cent. in 1922. The United Kingdom and France took the largest percentages, 65·4 and 25·5 per cent. respectively, of Canada's total exports of refined sugar in 1923, while in 1922 the United Kingdom received 70 per cent. and France only 6·7 per cent. of the total.

The imports of raw sugar into Canada were nearly 350,000,000 lbs. less in 1923 than in 1922, there being imported in 1923, 848,531,908 lbs. as against 1,197,609,010 lbs. in 1922. These imports came principally from the following countries, arranged in the order of the quantities imported: British Guiana and other parts of the British Empire, 289,843,512 lbs.; San Domingo, 173,061,354 lbs.; Cuba, 161,783,547 lbs.; United States, 98,198,457 lbs.; and the Dutch East Indies, 64,483,960 lbs.

SUGAR EXPORTS FROM SALVADOR.

Of the 9225 metric tons of sugar exported from Salvador during 1923, the United States took 7464 tons, France 729 tons, Netherlands 673 tons, Honduras 192 tons, and other countries 166 tons. Local consumption of sugar is estimated at 12,000 metric tons. The sugar crop begins in November and closes in May and it is estimated that with the increased number of plantations the production for the coming year will be larger than that of 1923.

CHILE'S BEET SUGAR INDUSTRY.

A commission recently appointed by the Chilean Government to study methods of encouraging the beet sugar industry in Chile, has reported that State aid is essential at least during the first few years. The chief features of the commission's recommendations are the payment by the Government during the period of 12 years of bounties for sugar produced, and increases of 50 to 100 per cent. in duties on all sugar imported.

The beet sugar industry in Chile has never passed the experimental stage, although the production of sugar from beets has been studied for a great many years in Chile. Several attempts have been made at different times to establish the industry, but without success. A beet sugar factory was operated near Santiago in 1885, proving the practicability of producing beet sugar in Chile, and later a second factory was built in the Province of Linares. The first factory was destroyed by fire in 1891 and the second was a failure financially.

The sugar refinery at Penco, which refines imported Peruvian raw sugar, has experimented with beets, as have the Government agriculture experts and others, and results obtained show that there is plenty of land in southern Chile suitable for sugar beet culture. Sugar beets can be grown without irrigation, from the Bio-Bio River, on which Concepcion is located, as far south as the River Aysen in the Province of Llanquihue, and on irrigated lands north of Concepcion. There is apparently no reason why Chile should not supply all the sugar required for domestic consumption from this source. During 1922 Chile imported a total of 98,672 metric tons of sugar, of which 97,249 tons came from Peru and about 900 tons from the United States.

MEXICAN SUGAR PRODUCTION IN 1923.

Sugar production in Mexico for the year 1923 amounted to 100,971 metric tons of refined and 20,500 tons of unrefined sugar, or a total of 121,472 metric tons, according to official reports. The total cane production amounted to 1,689,772 metric tons. In addition, from the by-product of 33,637 metric tons of cane molasses 194,796,003 litres of alcohol were distilled.

The total area under cultivation in sugar cane was 38,613 hectares, and Vera Cruz and Sinaloa, in the order named, were the two largest producing States. The production of refined sugar in the principal producing States follows: Vera Cruz, 40,093 metric tons; Sinaloa, 32,473 tons; Jalisco, 7185 tons; Yucatan, 4093 tons; Puebla, 3763 tons; Tabasco, 3600 tons; Nayarit, 3150 tons; and Michoacan, 2956 tons.

During the year 235 sugar mills were in operation, the greater number being located in various States as follows: Michoacan, 37; Vera Cruz, 34; Nuevo Leon, 27; Jalisco, 26; Chiapas, 26; and Sinaloa, 25. That many of the Mexican mills are small and unimportant is seen by the fact that some of the smaller producing States have a large number of mills. On the other hand, the sugar production of Puebla is credited almost entirely to two sugar mills.

ARGENTINE SUGAR CROP FOR 1923.

The Argentine sugar mills completed the grinding of cane during November and statistics for the entire Republic show a total of 3,749,746 metric tons of cane milled, which produced 256,904 metric tons of sugar. The distribution of the crop by provinces was as follows:—

Provinces.	Ground Cane. Metric Tons.	Sugar Produced. Metric Tons	Provinces.	Ground Cane. Metric Tons.	Sugar Produced. Metric Tons
Tucuman.. ..	3,022,310 ..	201,126	Sante Fe	8,475 ..	413
Jujuy	497,730 ..	40,268	Corrientes	15,530 ..	930
Salta..	137,460 ..	9,612	Chaco Austral...	68,238 ..	4,550

The stock of sugar on hand January 1st, 1923, was estimated at 128,000 metric tons and 17,000 tons were imported during the present year. These figures combined with the 1923 production of about 257,000 tons give a total of 402,000 tons, from which about 5000 tons may be estimated as refinery losses. This leaves a total of 397,000 metric tons available for consumption. It is estimated that the sugar consumption of the Republic from January 1st, 1923, to May 31st, 1924, which is the date of the beginning of the new crop, will be about 374,000 tons. The present year's sugar crop, therefore, will more than suffice for the consumption without further importations.

PROPOSED LATVIAN SUGAR INDUSTRY.

A new company has recently been formed in Latvia, known as the "First Latvian Sugar Refinery (Ltd.)," which will establish a factory in Courland. The proposed plant is expected to be in operation by the latter part of 1925, with a capacity for 450 tons of sugar beets daily, and drawing from about 3,600 acres of land sown to sugar beets. It is reported that two more sugar factories in Latvia will be opened within a comparatively short time, in the Mitau district and in Courland.

Publications Received.

Sugar Machinery: a Descriptive Treatise devoted to the Machinery and Processes used in the Manufacture of Cane and Beet Sugars. By A. J. Wallis-Tayler, A.M.I.C.E. Second Edition. Demy 8vo; xvi, 410 pp. with 163 illustrations. (William Rider & Son, Limited, London.) 1924. Price: 12s. 6d. net.

This is the second edition of a smaller book by the same author published in 1908. It has been largely rewritten and expanded (the preface explains), several new chapters dealing with the growth of the beet, the manufacture of beet sugar, sugar refining, and the distillation of rum having been included. Moreover, a number of additional illustrations now appear. It is, however, hardly possible to pronounce a more favourable opinion regarding this second edition than has been held of its predecessor. Perhaps the best that can be said of it is that certain of the descriptions of the apparatus and accessories used in the cane industry are quite well done, and that a few of the new illustrations are well selected. But having said that, we regret it is not possible to add much more in commendation of the book. Errors and omissions abound in it, and it contains an extraordinary amount of obsolescent and obsolete matter.

In regard to the errors and omissions, some of these are as follows:—The formulæ for "crystallized sugar" and certain saccharates are wrongly given; the description of cane varieties is long out-of-date; seedling canes are not mentioned; as an illustration of the sugar cane, that published in Porter's book of 1842 is reproduced; the object of using SO_2 is said to be to retard fermentation; descriptions and illustrations of sulphitation plant are omitted; carbonatation as used in Java is pronounced as not seeming a desirable one, because a brown colour which is difficult to get rid of is imparted to the sugar; beet sugar is stated to be invariably manufactured as refined; rasping and pressing are described for the extraction of juice from the beet (though diffusion is also described); filtration of the juice through animal charcoal is given as the practice in both the cane and the beet industries; the osmosis process is said to be employed to a considerable extent in French factories; in the beet section a paper by MELIN published in 1883 has been drawn upon largely for information with the result that the account of this industry is long since out-of-date; and in the chapter on refining the affining operation is omitted. As to obsolescent and obsolete matter, there is quite an amount of this here and there throughout the book, descriptions of apparatus and processes probably unknown to most modern sugar technologists being given without indication of their archaic nature. Considering the book as a whole, we are thus unable to recommend it. It does not in general represent modern practice in regard to the "machinery and processes used in the manufacture of cane and beet sugars"; and a considerable amount of the information it contains is of quite an unreliable nature.

Report of the Boiler Code Committee on the Construction of Steam Boilers. (American Society of Mechanical Engineers).

Contents: Part I (new installations) section 1; power boilers (selection of materials; specifications for boiler plate steel, boiler rivet steel, staybolt steel, steel bars, steel castings, gray iron castings, malleable castings, boiler rivet iron, staybolt iron, refined wrought-iron bars, lapwelded and seamless boiler tubes). Part I, section 2; boilers for low pressure steam. Part II (existing installations); maximum allowable working pressure, strength of materials, safety valves, fittings and appliances, appendix, efficiency of joints, braced and stayed surfaces, automatic water gauges, fusible plugs, recommendations for repairs, etc.

The British Sugar Beet Society announce that in order to acquaint the general public with the manufacture of sugar from home-grown beet, a short film is being released by Pathé Pictorial During the next few months it will be shown in more than a thousand cinemas in England.

Review of Current Technical Literature.[1]

LODGING OF SUGAR CANE, ITS EFFECT ON THE QUALITY OF THE JUICE, AND MEANS FOR ITS PREVENTION. *J. M. Geerts. Archief, 1923, 31, No. 22, 513–522.*

Fallen cane was harvested and worked up in the factory separately, when figures were obtained showing clearly the difference in the quality of the juices obtained. Thus, the average purity and sucrose content of the fallen cane were: 85·87 and 14·10; while the values for the standing cane (same variety, viz. D152, grown in Godeo, Java) were 91·15 and 17·31; and not only were the analyses of the fallen cane inferior but its average weight was smaller. Regarding the causes of lodging, these are many, and in the same field the amount of fallen cane varies in different parts. Some varieties are more predisposed to lodge than others, 100 POJ, for example, whereas EK2 and D152 show this inherent tendency to a much less extent. A second cause is lack of sufficient moisture during the earlier period of its growth, so that a spindling stalk is developed; while another cause is heavy fertilization, which may result in a condition of affairs under which the depreciation caused by the lodged cane may considerably discount the value of the added fertilizer. Coming to discuss measures for the prevention of lodging, the first obviously is the selection of a variety which does not appear to be disposed to this defect. Shallow planting by the ploughing system, as practised in Java, results in much standing and more fallen cane than when the Reynoso system is followed. Tying together stalks in opposite rows is more or less effective, but is costly, and produces an amount of bent cane; while the tops of the stalks are so crowded together that the yield is adversely affected. One of the measures that has been tried is stripping some of the lower leaves of the young cane, or cutting off the top of the cane about 2½ in. above the upper node; but, although this may retard lodging to some extent, it also diminishes the yield, and therefore can hardly be recommended as a practical preventative measure.

CLARIFICATION OF RAW CANE JUICES FOR THE DETERMINATION OF SUCROSE BY DOUBLE POLARIZATION OR OF REDUCING SUGARS. *E. Haddon. Communication to this Journal, dated February 14th, 1924.*

Some time ago[2] the author proposed the use of sulphurous acid in the determination of sucrose in factory products. This reagent gives very good results, but it has the disadvantage of not being easily prepared in every sugar-house laboratory. A certain number of chemists have tried it, but often they have had to give it up on account of the want of a suitable water supply under pressure for working the small furnace producing the SO_2. Other chemicals have been tried by the author, and in acetic acid, together with decolorizing carbon, he finds the best substitute. As has already been pointed out, there is little adsorption of sucrose by animal charcoal in acid solution; but when vegetable carbon is available it is better to use it, as even in neutral solution less adsorption takes place. Regarding the *modus operandi* adopted by the author (which can be used for any products of the factory), this is as follows:—To 100 c.c. of juice, 3 c.c. of strong acetic acid are added, and the volume completed to 200 c.c., the liquid being then filtered through carbon mixed up with one-third of its volume of kieselguhr. It is to be noted that the amount of acetic acid used should always be equal to that of the carbon, i.e., 1 c.c. of acetic acid to every grm. of carbon. For the determination of the sucrose in this liquid, any modification of the double polarization method may be used, provided that the details of the procedure chosen are strictly adhered to consistently. In connexion with this point, it may be mentioned that SAILLARD[3] has shown that neither the saccharimeter nor the formula need be blamed in most cases when unreliable results are obtained, the differences observed being generally due to the details of the adopted method not being always exactly followed. By using acetic acid (of the previous use of which for the clarification of products for analysis in this way the author is not aware) the influence of the volume of the precipitate is avoided, which error varies with the particular chemical used. Furthermore, on hydrolysis with hydrochloric acid there is no formation of another precipitate (lead chloride, for example, when lead acetate has been used for the previous clarification). It is worth while drawing attention to the fact that, when comparing the glucose content of factory sulphited juices for the detection of inversion, the action of sulphurous acid on the metal with which it has been in contact should be borne in mind, since SO_2 in contact with some metals (particularly zinc) produces hydrosulphites, which reduce Fehling's solution. In this way, one may conclude that inversion has occurred whereas none had taken place at all.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *Bulletin de la Société des Chimistes de Maurice*, 1918.

[3] *Journal des Fabricants de Sucre de France*, October 20th, 1922.

ACTIVATED (DECOLORIZING) CARBON. *Arthur B. Ray.*[1] *Chemical and Metallurgical Engineering, 1923, 29, No. 9, 354-357.*

This article deals with the application of activated carbons to the industrial adsorption of gas and vapour, and discusses the following matters: Essential characteristics of gas-adsorbing carbons, as physical structure, sorptive capacity, selectivity of adsorption, recovery of sorbed vapour and gases; commercial applications of gas-adsorbing carbons, e.g., for the separation and recovery of gases and vapours (benzol, petrol or gasolene, petroleum ether, sulphuric ether, alcohol, and industrial stenches), the storage of gases, catalysing reactions, and for obtaining high vacua.

INFLUENCE OF THE VOLUME OF WATER-INSOLUBLE MATTER ON THE POLARIZATION OF RAW SUGARS. *G. H. Hardin. Industrial and Engineering Chemistry, 1924, 16, No. 1, 55-56.*

Analyses of more than one hundred different makes of Cuban raws, carried out at the New York Sugar Trade Laboratory, showed the total insoluble matter to average 0·16 per cent., 0·14 per cent. being organic (*bagacillo*, etc.), and 0·02 per cent. mineral (sand, clay, etc.). When the insoluble matter in a raw sugar reaches 0·2 per cent., it will cause an increase in volume of 0·028 c.c. when 26 grms. are dissolved in 100 c.c. of water, which amount may be very small, but all the same should be borne in mind on the principle that the small errors in polarimetric testing are largely additive, and that small differences are recorded in a general average. About 15 per cent. of the Cuban raws examined at the Laboratory contained on an average 0·25 per cent. of insoluble matter, which gives an increase in polarization of 0·03 per cent. If a considerable amount of insoluble matter is observed in a raw sugar, and a true polarization is required, Scheibler's well-known double dilution method should be applied for the correction, or the value may be calculated from the weight and the specific gravity of the insoluble matter.

QUALITY (ESPECIALLY "FILTRABILITY") OF RAW SUGAR FOR REFINING. *S. S. Peck. Report of the Committee on the Manufacture of Sugar, Hawaiian Sugar Planters' Association, for Year ending September 30th, 1923.*

Complaints have been received from the refiners regarding the difficult filtration of liquors obtained by melting Hawaiian raw sugars,[2] and in a general way it may be stated that the cause is simply poor clarification. It is the impurities extracted in milling, and remaining after liming, that causes the trouble, among which objectionable substances the waxes are pre-eminent in their retarding action. More recently the refiners have complained of a higher ratio of ash to total non-sugars, but this has been found to be a general condition in all the factories in the Territory, so that it is reasonable to presume that it is caused by seasonal influences, or the varieties of cane ground, or to both causes. High liming would account in part for the higher total ash content, but not for the greater amount of soluble sulphates observed. Dr. W. D. HORNE has suggested a double clarification process, using a slight excess of lime, followed by a precipitant, presumably phosphoric acid. But while this treatment will doubtless reduce the total ash, including the lime, it is difficult to see how it can lower the soluble sulphate content.

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[1] Union Carbide and Carbon Research Laboratories Inc., Long Island City, N. Y.
[2] *I.S.J.*, 1923, 86.

ADVANTAGES OF "LA FEUILLE" ROTATING BAGASSE DRYER. *Anon. Sugar News, 1924, 5, No. 2, 80-83.*

This is a trade notice on the advantages of using an apparatus for the partial drying of the bagasse, the main points of which are here reproduced: Burnel and Fribourg have calculated that 100 kg. of bagasse with 50 per cent. of water effect the same evaporation as 63 kg. with 30 per cent. of water; and further that this 100 kg. of bagasse with 50 per cent. of water gives on drying 71·43 kg. of bagasse containing 30 per cent. of water. Therefore, instead of burning 100 tons of bagasse with 50 per cent. of water every 24 hours, the same degree of evaporation can be obtained with 63 tons previously dried to 30 per cent., thus saving 71·43 — 63·0 = 8·43 tons of bagasse with 30 per cent. of water, equivalent to 7718 kg. of firewood dried in the open to 25 per cent. of water. In the case of a factory crushing 500 tons of cane containing 11 per cent. of fibre in 24 hours, and producing a quantity of bagasse with about 50 per cent. of water, this means a saving of about 10 tons of wood per day. When the bagasse contains more than 50 per cent. of water, the more necessary it is that it should be dried, its calorific value diminishing rapidly in relation to the increase in the water content. Thus, if to replace 1 kg. of coal of a given kind 3·93 kg. of bagasse with 50 per cent. of water are required, then 5·41 kg. would be necessary if the bagasse had 60 per cent. of water, that is to say an increase of more than 37 per cent. of its weight. It is not desirable to reduce the water content of the bagasse below 30 per cent., inasmuch as in this case it does not burn well in most furnaces. Now, in regard to the drying of bagasse before burning it, the practice is economical only if this can be done at little or no extra cost, and the solution of the question is found in the utilization of the heat in the waste flue gases from the furnaces, the temperature of these being 250° C., and very often higher, while the volume of the gases is sufficient to dry all the bagasse produced in the factory. This utilization of waste heat can be realized in a practical manner by the invention of "La Fueille" dryer,[1] which has been applied to the drying of bagasse with 52 per cent. of water in certain factories in Egypt. This rotary apparatus has a drum at least 4 ft. long, and is capable of drying the bagasse from 500-600 tons of cane per day, reducing its water content from 51 to 34 or 35 per cent., which latter figure may be quite regularly controlled. In addition to the economy of fuel which is effected, the preliminary drying of bagasse in this way has the advantages firstly, that it permits elasticity in the production of steam, making possible a rapid increase of pressure when required; secondly, that it facilitates the regulation of furnaces; and, thirdly, that it reduces the heating surface by permitting the use of fewer boilers. Bagasse economized in the use of this apparatus may of course be used for the distillery, if one is attached to the factory, or it can be made into briquettes for use as fuel for locomotives, as is done in Java.

DIFFERENCE IN THE RESULTS GIVEN BY CERTAIN MODIFICATIONS OF THE DOUBLE POLARIZATION (CLERGET) METHOD OF DETERMINING SUCROSE IN CANE MOLASSES. *A. W. Woods. Reports of the First Annual Convention of the Philippine Sugar Association, Manila, P.I., October, 1923.*

Mr. Woods[2] describes four different methods for the determination of sucrose in final molasses by double polarization, these briefly described being as follows: (1) *Walker's method without using phosphoric acid.*—71·5 grms. of the sample dissolved in water in a 500 c.c. flask, treated with 80 c.c. of basic lead acetate solution, made up almost to the mark with water, allowed to stand for half-an-hour, the volume completed, and the whole mixed, and read in the 200 mm. tube. For the direct reading 50 c.c. of the filtrate in a 50-55 c.c. flask are treated with about 2 c.c. of a saturated solution of aluminium sulphate, made up to 55 c.c., allowed to stand ½ hour, filtered and polarized. For the inversion reading, 75 c.c. of the filtrate in a 100-110 c.c. flask, are mixed with 2 c.c. of HCl (1:1), heated to 65°C. in a water-bath, 10 c.c. of HCl (1:1) added immediately, the liquid allowed to stand for at least 15 mins., cooled, made up to 110 c.c., filtered, and read in the 200 mm.

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[1] Made by the Société Anonyme des Ateliers de Construction Gilain.

[2] Chief Chemist, Hawaiian Philippine Co., P.I.

tube. (2) *Walker's method using phosphoric acid.*—A solution of 52 grms. of molasses dissolved in 300 c.c. of water is treated with 15–20 grms. of *dry* basic lead acetate together with a few grms. of dry sand, and filtered; to 75 c.c. of the filtrate in a 100 c.c. flask, 20 c.c. of a solution containing 100 grms. of phosphoric acid per litre are added, made up to 100 c.c. with water, and filtered, the clear liquid being read in the 400 mm. tube to give the direct polarization. For the inversion reading, 75 c.c. in a 100 c.c. flask, are treated with HCl to neutralize the alkalinity due to the excess of lead remaining, heated to 65–70°C., mixed with 10 c.c. of HCl (1 : 1), allowed to stand in the air for at least 15 mins., cooled, made up to 100 c.c., filtered, and polarized in the 400 mm. tube. (3) *Hawaiian Chemists' Association Method.*—For the direct reading, the procedure is the same as for Method (1); while the inversion reading is carried out in a manner similar to that followed in the well-known Herzfeld method. (4) *Steuerwald's Method.*—This has already been described.[1] Its direct reading is obtained with a solution of basic lead acetate in the usual way, but the inversion reading is found by mixing 50 c.c. of the filtrate from the direct reading with 30 c.c. of HCl (1·10 sp. gr.), and setting the liquor aside for 3 hours at 30–25°C., and finally polarizing in the water-jacketed tube, as usual. Mr. WOODS pointed out in regard to Walker's method using phosphoric acid that (as Brodie has found[2]) it gives results which are 0·3–0·5 per cent. too low when working with mixtures of which the sucrose content is known, owing to inversion by the phosphoric acid, of which much more is used than that required to precipitate the lead and restore the normal rotation of the levulose. When a small excess of the acid is used, the method is considered to give very accurate results; and in this form it has the following advantages: The error due to the volume of lead precipitate is eliminated; the solution used for the direct reading is light in colour, being easily read in the 200 mm. tube; and the inversion reading is made in a half-normal solution. Determinations made by Mr. CARLOS LOCSIN of the sucrose content of Philippines waste molasses by the four different methods show the following average results:—

	No.	Brix.	Polarization.	Apparent Purity.	Sucrose.	Gravity Purity.
Method 1.. ..	1	88·40	32·40	36·65	36·04	40·77
	2	88·40	32·60	36·88	36·17	40·92
Average		88·40	32·50	36·77	36·11	40·85
Method 2.. ..	1	88·40	30·60	34·62	34·17	38·65
	2	88·40	30·60	34·62	34·30	38·80
Average		88·40	30·60	34·62	34·24	38·73
Method 3.. ..	1	88·40	32·40	36·65	36·05	40·78
	2	88·30	32·40	36·69	36·15	40·94
Average		88·35	32·40	36·67	36·10	40·86
Method 4.. ..	1	88·35	30·58	34·61	35·24	39·89
	2	88·40	30·36	34·34	35·06	39·66
Average		88·38	30·47	34·48	35·15	39·77

Preservation of Samples of Juice after Collection for Laboratory Analysis.

W. K. Orth. *Report of the Committee on Juice Preservation; presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.*

In regard to the question of the deterioration of samples of juice taken for analysis, the author gives an account of some experiments conducted in the laboratory of the Ewa mill, T. H., with the use of various preservatives, the following being a summary of the results for the glucose ratio (*a*) immediately after collection, and (*b*) after 24 hours:—Dry basic lead acetate, 12–14 grms. per litre of juice, (*a*) 5·10; (*b*) 5·11. Mercuric chloride, 3 grms. per litre, (*a*) 5·50; (*b*) 6·36. Sodium benzoate 3 grms. per litre, (*a*) 4·43; (*b*) 7·29. Toluol, 50 c.c. per 1500 c.c. (*a*) 7·93; (*b*) 11·99. These results, therefore, show that dry basic lead acetate and mercuric chloride are satisfactory as preservatives when used in the proportions stated; but that sodium benzoate and toluol are ineffective.

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[1] *I.S.J.*, 1918, 489.

[2] *Ibid.*, 1920, 174.

IMPORTANCE OF CLEANLINESS AT THE MILL. *Tomas Ferraris.* *Reports of the First Annual Convention of the Philippine Sugar Association, Manila, P.I., October, 1923.*

At Ma-ao Central, P.I., the sanitary precautions practised in the milling department[1] are said to have rendered a large saving of sugar in the bags. All pipes through which the mixed juice passes, and all tanks, are sterilized from time to time with live steam. This prevents any possible fermentation that may develop inside the pipes and the unfilled parts of the containers. Mill beds, particularly those in contact with cane juices, are washed with hot water twice every 24 hours, and powdered lime is dusted upon the mill beds after each washing. Macerating juice of the last mill is supplied with a constant flow of milk-of-lime (at 15° Bé.) through a 1 in. pipe from a barrel supply tank. Besides the above-mentioned sanitary practices, a tank filled with 1 per cent. formaldehyde solution provides a spray through a ¾ in. pipe for the bagasse after the third mill. These precautions are responsible for the small difference between the crusher and the mixed juice purities which has recently been recorded, and are summarized in the following table. During the first two crops, mill sanitation was not strictly attended to at this central.

Crop.	Purity of the Mixed Juice.	Purity of the Crusher Juice.	Purity Decrease.
1920-1921	82·6	80·2	2·4
1921-1922	84·7	81·9	2·8
1922-1923	86.8	85·4	1·4

PRODUCTION OF A SODIUM FLAME FOR USE WITH THE POLARIMETER. *Paul E. Klopsteg.* *Industrial and Engineering Chemistry, 1924, 16, No. 3, 320.*

Referring to the apparatus described recently by DOLID,[2] this is similar to one which has been listed for a number of years by chemical apparatus supply companies, and is very satisfactory as long as the asbestos wick does not become clogged. Another apparatus also listed utilizes an aspirator of special design by means of which the salt solution is drawn in a fine spray into the gas which feeds the flame. This method operates satisfactorily, as long as there is no difficulty from contaminating the flame with salts that are not supposed to be there. With the asbestos wick it is almost impossible to avoid the latter trouble when salts other than those of sodium are used.

MANUFACTURE AND USE OF COMMERCIAL INVERT SUGAR. *Stroud Jordan.* *Industrial and Engineering Chemistry, 1924, 16, No. 3, 307-310.*

This article, which is of a general nature, gives information regarding the history of invert sugar, its preparation, its manufacture, and its uses, while there is also a short review of patent literature relating to it.

CENTRIFUGAL MACHINES. *E. A. Alliott.* *The Chemical Trade Journal, 1924, 74, No. 1920, 281-283.*

This is an article giving an outline of the construction and use of centrifugal dryers for general purposes, and covers the following points: Constructional details; main types of machines; relationship betwen speed and efficiency; distribution of moisture in the load; influence of the size of grain; figures showing moisture content of various materials, time of spinning, and density of product; labour and output; and recent developments in centrifugal construction.

J. P. O.

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[1] See also *I.S.J.*, 1923, 32.

[2] *I.S.J.*, 1924, 111.

Review of Recent Patents.[1]

UNITED KINGDOM.

REVIVIFICATION OF ANIMAL CHARCOAL (BONEBLACK) BY MEANS OF SUPERHEATED STEAM.

Matthew Russell, of Greenock, Scotland. *210,232.* December 6th, 1922.

A process for revivifying charcoal or other carbonaceous filtering medium while in the filter chamber comprises subjecting the filtering medium to superheated steam at a temperature above approximately 600° F. (316° C.), the superheated steam being passed through the filter chamber when the filtering medium has become spent or reached its limit of usefulness. It comprises the further step of cooling the filtering medium by passing saturated steam through the filter chamber. For the purpose of carrying out the invention, the filtering chamber, which may consist of a cistern or containing vessel of cast-iron, steel, or other suitable metal, is preferably lined with fire-brick or other non-conducting material and may be lagged outside, if desired. The filter chamber is fitted with the usual valves for liquor, water, and air; but, in addition thereto, valve-controlled pipes are fitted to admit highly superheated steam at a very low pressure, and also saturated steam at low pressure in the case of existing filter vessels which are not suitable for pressures above 10 lbs. per sq. in. In the case of filter vessels constructed specially for this process, the limit of pressure would depend only on the strength of the vessel. One method of filtering according to the present invention would be as follows:—The liquor is run through the filtering chamber until such time as the char has reached its limit of usefulness, when the liquor supply is cut off and the liquor drained from the filtering chamber. The filtering medium is then washed, and air may be introduced to dry it in known manner, after which superheated steam is introduced, preferably at a very low pressure and at a temperature of from 600 to 1000° F. (316 to 538° C.). The superheated steam completely revivifies the charcoal, which may be thereafter cooled by introducing low pressure saturated steam into the filtering chamber; and, as the saturated steam is superheated before leaving the filtering chamber, it may be conveyed to the next filtering chambers for the purpose of partially heating up or revivifying the charcoal or other filtering medium contained therein. The charcoal or filtering medium gradually increases its percentage of carbon and impurities after continued use, which percentage may be reduced or maintained at any desired figure by introducing the necessary quantity of air with the superheated steam, in order to decarbonize the filtering medium. Alternatively, the cooling and decarbonizing of the filtering medium may be effected by introducing or blowing air through the filtering medium to burn off the excess of carbon. In filtering apparatus using charcoal or other carbonaceous filtering medium for the decolorization of sugar liquors, a quantity of sugar is retained in the filtering medium before commencing washing and revivification thereof, which sugar is so diluted in the washing operation that it is uneconomical to evaporate these washings for the purpose of recovering the sugar. It is a further object of the present invention to enable the whole of the sugar so retained in the filtering medium to be recovered. For this purpose, immediately after the liquor supply has been cut off, saturated or superheated steam may be admitted with or without water, the admixture of water depending on the temperature of the filtering medium. The temperature of the combined water and steam supply should preferably be between 200° to 220° F. (93 to 104° C.), so as to ensure that the whole of the sugar is recovered in solution with the minimum amount of water and condensed steam. The steam and water pressure adopted during the recovery of the sugar, and the steam pressure adopted during the revivification of the filtering medium, may vary up to the permissible working pressure allowable in the filtering vessel. The temperature of the filtrate and filtering medium is so arranged that caramelization, destruction of sugar, or chemical change, in the filtrate is avoided by regulating the said temperature between the limits of 200° and 220° F.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France;* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

ALCOHOL MOTOR FUEL. *A. E. Dunstan and F. B. Thole,* of Sunbury-on-Thames. *205,367.* November 16th, 1922.

A homogeneous and stable mixture of alcohol and a liquid hydrocarbon, such as a mineral oil distillate, petrol, white spirit, light kerosene, or shale spirit, is prepared by cooling the mixture to from zero to — 20°C. and removing the shallow denser layer of aqueous alcohol and hydrocarbon which separates out. Mixtures containing up to 50 per cent. of alcohol give satisfactory results, and the separation may be effected in stages. In an example, 900 parts of petrol and 100 parts of alcohol are cooled to — 10°C. The dense layer containing the water may be mixed with fresh petrol to extract more alcohol.

ALCOHOL MOTOR FUEL. *P. Lennox and Sir J. C. Calder,* Calder House, London. *205,582.* July 21st, 1922.

Liquid fuel suitable for use in internal-combustion engines consists of an alcohol, a hydrocarbon, and water in such proportions as to form a homogeneous solution. Pyridine may be added to denature the alcohol, and either picric acid or a peroxide and hydrochloric acid, or both, to assist combustion. In an example, 92 litres of crude commercial alcohol, 5 litres of benzol, and 3 litres of pyridine are churned together, and the mixture is afterwards churned with an equal volume of water. To each litre of the solution are added 0·67 grm. of barium peroxide and 0·2 grm. of hydrochloric acid, and 0·67 grm. of picric acid. The solution is heated to 38°C. after addition of the picric acid. Specifications 3899/14, 111,661, 167,831, and 183,577 are referred to.

ALCOHOL MOTOR FUEL. *J. de Cosmo,* of Neuilly-sur-Seine, France. *205,070*; addition to *111,67/13.* September 27th, 1923; convention date, October 3rd, 1922.

A liquid fuel for explosion motors consists of a mixture of alcohol, naphthalene, cresol, naphthalene derivatives such as naphthylamine or nitronaphthalene, "crystallizable benzine," and ether or petroleum spirit or benzine.

ALCOHOL MOTOR FUEL. *I. Diamond,* of 22, Basinghall St., London. *207,883.* September 7th, 1922.

Nicotine or other alkaloid is added to an alcohol fuel. In an example 60-100 gall. of ethyl alcohol or methylated spirit; 40-80 gall. of ether; 25-60 gall. of benzol; and 2-4 oz. of nicotine are mixed together, and distilled over lime.

MANUFACTURE OF GLUCOSE, ALCOHOL, AND OF A RESIDUE FOR MAKING PRODUCER GAS. *W. P. Perry,* of Leytonstone, London. *207,598.* August 28th, 1922.

Wood or other cellulose material is heated with a hydrolyzing agent (such as a mineral acid) and is pressed to remove saccharine liquor which is fermented to produce alcohol. The residue is distilled in a gas-producer preferably of the kind described in Specification 203,144.

PREVENTION OF INCRUSTATION AND CORROSION IN EVAPORATORS, VACUUM PANS, BOILERS, ETC.[1] *K. Schnetzer,* of Aussig, Czecho-Slovakia. *208,115.* July 31st, 1923; convention date, December 7th, 1922.

Scale formation or adhesion in steam boilers, evaporators, economisers, condensers water pipes, and hot water apparatus is prevented by connecting the poles of a source of direct current to opposite points of the boiler shell, the voltage of the source being less than that required for decomposition of the liquid. One or more thermo-couples heated by the boiler may be used to supply the current. Voltages from 0·005 to 0·05, and currents from one micro-ampere, to a few milli-amperes are stated to effect the required result.

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[1] *Cf.* also U. K. Patent, 180,696; *I.S.J.*, 1922, 496.

EVAPORATION WITH THERMO-COMPRESSION. *Metallbank und Metallurgische Ges. Akt.-Ges., and W. Gensecke,* of Frankfurt-on-Main, Germany. *208,130.* November 22nd, 1923; convention date, December 11th, 1922.

In evaporating liquids at low temperatures and under reduced pressure, the vapours produced in the evaporator are brought to a higher pressure by passage through a compressor, preferably of the jet type before being led into the condenser, which may be of the surface or jet type. The steam leaving the jet may be sent through the heating system of the evaporator before being passed to the condenser.

DISTILLATION AND ALCOHOL DEHYDRATION. *H. Wade* (communicated by *Standard Development Co.,* of New York). *208,449.* March 3rd, 1923.

Ethyl alcohol is dehydrated by admixing with a hydrocarbon oil, preferably of higher boiling point than the alcohol, heating the mixture with lime and distilling off the alcohol. Suitable oils are kerosene, naphtha, naphtha bottoms, gas oil, etc. In an example, 95 per cent. alcohol is mixed with about 25 per cent. of kerosene (above 43° Bé), and 10–15 per cent. more lime than is required to combine with the water. The mixture is refluxed for some hours, and then distilled, the distillate being fractionated or condensed together, according to whether absolute alcohol is desired or not. If the vapours are condensed together, the mixture may be employed together with gasoline as a motor fuel. Kerosene may be recovered from the residue by passing in an inert gas, such as natural gas, under pressure with or without heat. Alcohol denatured with benzol, pyridine, wood alcohol, etc., may be similarly dehydrated.

DESTRUCTIVE DISTILLATION OF MOLASSES, SPENT WASH, ETC. (FOR THE PRODUCTION OF ACETONE, AMMONIA, TRIMETHYLAMINE, DECOLORIZING CARBON, TAR, ETC.) *Syndicat d'Etudes Chimiques,* of Brussels. *208,516.* October 25th, 1923; convention date, December 15th, 1922.

Factory and refinery molasses, distillery vinasse (spent wash) and like nitrogenous residues are mixed with lime or other alkaline substance and distilled in closed resorts under reduced pressure. The pyrogenous distillation of molasses, which has been de-saccharified with strontium hydrate, and to which lime has been added, yields ammonia, trimethylamine, acetone, and a non-nitrogenous tar, leaving a light carbon suitable for decolorizing purposes, and a mineral residue from which saline substances can be extracted. Distillery vinasses, treated in the same way, yield similar products.

PRODUCTION OF DECOLORIZING CARBON. *General Norit Co., Ltd.,* of 2, Den Textraat, Amsterdam, Holland, assignees of *J. N. A. Sauer*). *208,555.* November 20th, 1922; convention date, November 19th, 1922.

Decolorizing carbon is produced from pre-distilled carbonaceous materials, such as coke or charcoal, by a two-stage continuous process. In the first stage, the material is prepared for activation by the passage through it of the reaction gases from the second stage, while in the latter the material is activated by heat and gases. The reaction gases from the second stage may be mixed with hot substantially inert gases before passing to the first stage. The activating gases specified are steam, carbon dioxide and monoxide, air, hydrogen, chlorine, retort gases, volatilized chlorides, and water, coke-oven, or producer-gas. In addition mineral materials such as calcium or magnesium carbonate, quicklime, or slaked lime, calcium, magnesium, ammonium or sodium chloride, may be added to the charge. The process is carried out in a vertical or inclined retort, heated externally or internally by injection of burning or combustible gases or both internally and externally. The gases passing through, and distillation products from the material undergoing the first stage of the process, are preferably withdrawn at a point somewhat below the charging hopper. There may be in the retort a series of zones of different temperatures into each of which is injected the gas best adapted to react at that temperature. (Specification 167,195 is referred to).

UNITED STATES.

MANUFACTURE OF A NITROGENOUS FERTILIZER (FROM STRAW AND THE LIKE). *Eric H. Richards and Henry B. Hutchinson*, of Harpenden, Herts.[1] *1,471,979.* October 23rd, 1923. (Two figures; thirteen claims.)

If soluble nitrogen compounds be brought into contact with carbohydrate material, and fermentation be allowed to proceed under certain conditions, the soluble nitrogen is transformed into derivatives, which are insoluble in water, but are easily assimilable by plants. The characteristic feature of the invention resides in the utilization, as food for a group of organisms requiring nitrogen for the elaboration of their own bodies, of the more easily digestible portions of vegetable matter such as straw, dead leaves, bracken, or other suitable carbonaceous material. These organisms are highly aërobic and, under proper aërobic conditions, in presence of nitrogenous solutions, such as, for example, solutions of ammoniacal nitrogen, they take nitrogen from the solution and carbon from the more digestible constituents of the carbohydrate-containing matter, and effect the combination of these elements with the production of insoluble derivatives in their own cell-structure or excretions. They are normally present in soil, hence are found in substances such as straw. An organic nutrient which has been inoculated with these organisms may be conveniently designated as fermentable carbohydrate-containing material. Before such material can function satisfactorily in nitrogen fixation, however, a certain condition of development of the organisms must be brought about. Fermentable material in which this condition has been established is hereafter referred to in this specification as being "activated." The action of these organisms has definite limits, and, given appropriately activated material, the other essential factors for successful nitrogen recovery are a suitable period of contact between the said material and the nitrogenous solution, and the maintenance during contact of a proper reaction and effective aërobic conditions. An example of a convenient mode of procedure for carrying out the invention when manufacturing plant is not available is as follows:—1 ton of dry straw is built up into a heap, and in so doing there is mixed in 1 cwt. of ammonium sulphate and 1 cwt. of fine chalk or limestone. Water is then added cautiously so that none runs away, until about 4 tons have been absorbed by the straw. Alternatively, the straw and the chalk may be wetted first and the ammonium sulphate applied subsequently. The mass is then left for three months. Advantageously, the heap is turned over a month from the start. The figures given represent a nitrogen concentration of 0·25 per cent. initially, but of this a small proportion is lost in the three months, the remainder being transformed into organic combination. An original nitrogen concentration of 0·5 per cent. gives an equally good manure, but a high percentage of nitrogen is lost, an illustration of the economic advantage of not using nitrogenous solutions of too high a concentration.

PREPARATION OF DITHIOCARBAMIC COMPOUNDS FROM "BEET SUGAR RESIDUE" (MOLASSES). *Stuart B. Molony and Yasujuro Nikaido* (assignors to *Michigan Chemical Co.*, of Michigan, U.S.A.). *1,465,677.* August 21st, 1923. (No drawings; seventeen claims.)

"Beet sugar residues" (molasses) at a suitable density is introduced in continuous streams into a retort heated to cause destructive distillation, whereby vapours of an alkaline nature are evolved, their chief constituents being ammonia and certain amines. After being cooled, the vapours are passed into a receiver containing an acid (preferably sulphuric), the incondensible gases, such as carbon monoxide and cyanogen being led away into the atmosphere. The acid condensate, containing sulphates of ammonia and the amines, is concentrated under vacuum until most of the sulphate of ammonia crystallizes out, the sulphates of the amines remaining in the mother-liquor, which is separated by centrifuging, or other suitable means. An alkali, or alkaline earth (e.g. lime), is added to

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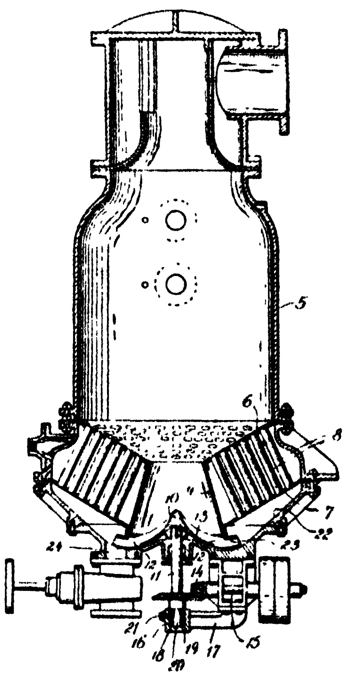
[1] At Rothamsted Experiment Station.

this mother-liquor in a steam-jacketed still, and the amine vapours evolved conducted into carbon bisulphide, whereupon a mixture of amino-ammonium dithiocarbamic salts is formed. Lastly water is added, and the layer consisting of the aqueous solution of the dithiocarbamic salts in a substantially pure state is separated.

VACUUM PAN HAVING FORCED CIRCULATION DEVICE. *Godfrey Engel, Sr.* (Assignor to *Buffalo Foundry and Machine Co.,* of Buffalo, New York). *1,476,331.* December 4th, 1923.

In dealing with heavy liquids (e.g. syrup), the temperature difference is not sufficient to effect a proper circulation through and about the calandria tubes of the vacuum pan, Therefore, to overcome this difficulty, the inventor mounts in the bottom of the pan below the central calandria passage, a forced circulation-creating device shown in the form of a propeller *10* carried by the shaft *11* and consisting of a series of curved impeller blades *12*. This propeller is shown as of generally conical shape, arranged with the apex thereof projecting up into the conical calandria passage and the lower edges of the blades are shown as connected for the greater portion of their length by a web *13*. The propeller shaft is driven through bevel gearing *14* from a power shaft *15* and a step bearing of novel construction is provided for the lower end of the vertical propeller shaft. This step bearing consists of a socket *16* provided in a suitable supporting bracket *17*, for receiving the lower end of the propeller shaft and forming the seat for the two bearing segments *18*, *19* which surround the lower end of the shaft and are formed with an upwardly convergent bore to receive the correspondingly shaped upwardly convergent lower end portion *20* of the shaft. The bearing segments are indicated as secured against removal from or shifting in their seat by a set screw *21*. This relatively simple construction, it will be observed, provides a thrust bearing in which a part of the bearing members serve to prevent the shaft from being lifted out of its seat. The bottom wall of the pan beneath the calandria is of generally inverted conical shape, inclined inwardly and downwardly towards the ends of the propeller blades, as shown at *22*, and that portion of the bottom of the pan which is located beneath the body of the propeller is shown as inclined upwardly. This promotes the flow to the propeller and up through the central calandria passage. The propeller is driven at the proper speed to effect the desired rate of circulation. For heating and evaporating purposes, the propeller is rotated to produce a downward circulation through the centre of the calandria and up through the tubes, heat being supplied to the calandria as by means of steam in the usual way. The fluid is positively circulated through the inclined tubes and across the inclined tube sheets and the material is prevented from lodging on either the sheets or in the tubes, both by reason of the inclination of these parts and because of the positive circulation produced by the propeller. With this apparatus relatively rapid and uniform evaporation and cooling effects are readily accomplished. The blades of the propeller in the illustration are shown connected at the rim by a flange *23* which stands substantially in line with the central circulating passage of the calandria, which serves to promote the circulation. The propeller furthermore is shown as having its blades extending over the outlet passage *24*. This is an important improvement in that it causes the blades to expel the material during discharge of the pan.



COMPOSITION CONTAINING KIESELGUHR AND CARBON FOR DECOLORIZING AND PURIFYING LIQUIDS (A SUBSTITUTE FOR BONE CHAR). *Walter L. Jordan*, of New York, N. Y. *1,448,846*. March 20th, 1923.

Kieselguhr (diatomaceous earth) is calcined at a sufficiently high temperature (e.g., 2200°F. or 1204°C) to cause a substantial increase in its mechanical strength, and to make it sufficiently coherent to prevent disintegration under the conditions of use. This calcined product is crushed to a suitable state of disintegration (preferably to granules corresponding to the usual size of particles of bone char); impregnated in a liquid such as blood, tankage or other packing-house waste, glue, cane or beet molasses, or concentrated paper lye from mills; charged into a retort and charred at a temperature sufficient to eliminate volatile constituents, but not high enough to cause conversion to graphite. In this way a granular composition is obtained which furnishes a comparatively rigid support for the carbon, which permits free circulation through the mass, and which is not as subject to disintegration as bone char.

ROTARY VACUUM FILTER. *Louis C. Rolls*, of Hedley, British Columbia. *1,475,244*. November 27th, 1923.

Claim 1.—A filter having in combination a continuously moving filtering surface, means for creating a vacuum at the filtering surface, means for covering the filtering surface with material to be filtered, means for supplying wash fluid to the surface of the material, and a series of rolls mounted to rest upon the surface of the material and interposed in the path of travel of fluid, all said rolls excepting the last one being provided with channels for the passage way of the fluid past the rolls.

PRIMING DEVICE FOR PUMPS. *Allever B. Seaborne*, of London, England. *1,474,449*. November 20th, 1923.

Claim 1.—A pumping and straining device[1] for centrifugal and like pumps comprising an interceptor or priming tank arranged between the suction pipe and the pump so that its contents are mostly above the level of the top of the pump casing, and an ejector and straining device within said tank so arranged that the liquid passing through the tank before entering the pump entrains the air accumulating within the tank, as set forth.

PRODUCTION OF PHOSPHORIC FERTILIZER. *Stapleton D. Gooch*, of Plant City, Fla., U.S.A. *1,470,968*. October 16th, 1923.

Claim 1.—The method of producing calcium phosphate which consists in directly subjecting finely powdered phosphatic material to the direct action of phosphorus pentoxide, and in agitating the phosphoric material in the presence of said gas.

CONFECTIONERY (CANDY) MANUFACTURE. (*A*) *Clyde J. Oyster*, of Alliance, Ohio, U S.A. *1,466,381*. August 28th, 1923. (*B*) *Laurence L. Blunt*, of Denver, Colo., U.S.A. *1,467,351*. September 11th, 1923. (*C*) *Wm. B. Laskey*, of Marblehead, Mass., U.S.A. *1,468,535*. September 18th, 1923. (*D*) *Willis N. Hartshorn*, of Racine, Wis., U.S.A. *1,469,316*. October 22nd, 1923. (*E*) *Harry B. Burt*, of Youngstown, Ohio, U.S.A. *1,470,624*; *1,470,625*. October 9th, 1923. (*F*) *Charles A. Plempel*, of Pittsburgh, Pa., U.S.A. *1,472,229*. October 30th, 1923. (*G*) *Frantiser Kubes*, of Prague-Wusle, Czecho-Slovakia. *1,471,697*. October 23rd, 1923. (*H*) *Edmund W. Roberts*, of Cincinnati, Ohio, U.S.A. *1,474,004*. November 13th, 1923.

PREPARATION OF DECOLORIZING CARBON, USING PHOSPHORIC ACID. *Claude S. Hudson*,[2] of Hyattsville, Maryland, U.S.A. *1,438,113*. December 5th, 1922.

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[1] Compare also *I.S.J.*, 1923, 584.

[2] See also U.K. Patent, 139,156; *I.S.J.*, 1920, 356.

Patents.

HOLLAND.

CRUSHER ROLL FOR CANE MILLS. *Jhr. Laurent G. G. Dibbets,* of The Hague, Holland. *3556.* May 11th, 1919.

The object of the invention is the provision of a roll having teeth which are so formed that: (1) They remain sharp longer than in the apparatus now used; (2) they are strong enough to withstand great pressures; and (3) they can very easily be sharpened. According to the specification, the crusher roll is provided with teeth in the form of curves running lengthways, these curves being inclined towards their convex side, and being limited by a part of the surface of the cylinder having the same axis as the roll itself. If the curves are the right distance apart, the result is that in milling there is an even action across the whole length of the roller. By making the ribs thicker in the middle they are strengthened in the place where most cane is introduced, while the slope of the teeth prevents the sharp edge from being blunted as quickly as in the present designs. Referring to the figures, it is seen that the roll *5* is provided with teeth *6* in the form of curves running lengthways, which teeth are inclined to the convex side of the curve, so that the gripping surface *a*, *b*, leans over. At *9* is indicated a groove in the thick, central portion of the teeth, the purpose of which is to permit the passage of juice.

Fig 1

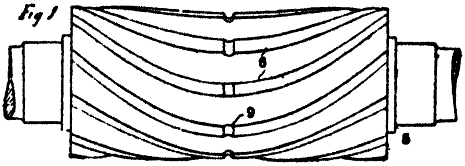
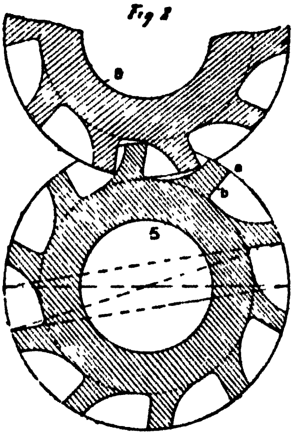


Fig 2



PROCESS FOR THE PURIFICATION OF GLUCOSE-CONTAINING SOLUTIONS OF SUGAR IN THE PRESENCE OF ALKALINE REACTING SUBSTANCES. *Hein Israël Waterman, Jacobus W. L. van Ligten, and Koloniale Bank,* of Amsterdam, Holland. *9260.* Published, July 16th, 1923.

This process relates to the purification of solutions of sugar containing reducing sugars ("glucose"), in which alkaline substances (e.g., lime) are present, so that the injurious action of the hydroxyl-ions on the reducing sugars is likely to occur. It is known that amino-acids (e.g., asparagine) are capable of inhibiting the decomposition of reducing sugars by hydroxyl-ions.[1] Further, that certain waste and intermediate products (e g., the molasses and syrups of cane sugar factories) contain considerable amounts of the amino-acids referred to, and of allied compounds. It is true that amino-acids are already present in the raw cane juice, and that in some cases during liming they exert a favourable effect; but with high hydroxyl concentrations their content in the raw juice is too small to protect the "glucose" completely. Hence, according to this invention, so much molasses or syrup is added, either before or soon after treatment with lime, so that the total quantity of non-sugar in the liquid is considerably increased.

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[1] *I.S.J.*, 1922, 157.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st.		Three Months ending March 31st.	
	1923. Tons.	1924. Tons.	1923. Tons.	1924. Tons.
Unrefined Sugars.				
Poland	....	5,151	....	19,608
Germany	....	....	....	
Netherlands	....	....	....	....
France	....	..	....	....
Czecho-Slovakia	.	....	..	....
Java	294	1	10,644	420
Philippine Islands	....	....	...	....
Cuba	39,667	68,228	42,084	86,292
Dutch Guiana	....	....	....	....
Hayti and San Domingo	7,811	10,898	11,652	21,674
Mexico	....	....	....	....
Peru	6,275	9,333	38,975	31,110
Brazil	5,439	....	43,608	20,480
Mauritius	31,357	11,693	112,916	84,402
British India	...	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	3,420	4,726	8,497	15,490
Other Countries	1,123	9,199	3,510	36,594
Total Raw Sugars	**95,386**	**119,230**	**271,884**	**316,072**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	2,140	15,540	12,237	49,425
Belgium	916	2,222	8,350	18,935
France	9	....	137	....
Czecho-Slovakia	7,806	2,020	27,092	22,436
Java	....	....	....	....
United States of America	7,104	2,629	9.794	3,593
Canada	2,126	4,139	3,020	5,120
Other Countries	1,972	2,593	9,431	15,679
Total Refined Sugars	**22,071**	**29,144**	**70,059**	**115,189**
Molasses	13,346	16,578	46,127	39,394
Total Imports	**130,803**	**164,952**	**388,070**	**470,655**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	26	71	269	121
Netherlands	113	29	423	110
Irish Free State	....	3,454	....	11,634
Channel Islands	84	62	341	264
Canada	....	....	....	....
Other Countries	520	570	1,484	1,718
	744	4,186	2,517	13,847
Foreign & Colonial Sugars.				
Refined and Candy	294	129	742	356
Unrefined	5,752	77	7,292	4,750
Various Mixed in Bond	....	....	....	....
Molasses	37	269	980	405
Total Exports	**6,827**	**4,661**	**11,531**	**19,358**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to March 27th	890,378	968,396
Deliveries „ „	878,630	957,557
Meltings by Refiners „ „	718,430	770,160
Exports of Refined „ „	9,250	30,000
Importers' Stocks, March 27th	12,542	10,839
Total Stocks, March 27th	194,711	209,355
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons	1923-24. Tons
Exports	253,940	886,195	883,915
Stocks	414,512	460,009	437,958
	668,452	1,346,204	1,321,873
Local Consumption	20,000	17,000	17,000
Receipts at Port to February 29th	688,452	1,363,204	1,338,873

Havana, February 29th, 1924.

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1922, 1923, AND 1924.

IMPORTS.	1922. Tons.	1923. Tons.	1924. Tons.
Refined	86,607	70,059	115,189
Raw	328,187	271,884	316,072
Molasses	21,171	46,127	39,394
	435,965	388,070	470,655

EXPORTS (Foreign).	1922. Tons	1923 Tons.	1924. Tons.
Refined	412	742	356
Raw	1,339	7,292	4,750
Molasses	379	980	405
	2,130	9,014	5,511

HOME CONSUMPTION.

	1922. Tons.	1923. Tons.	1924. Tons.
Refined	86,146	73,632	84,862
Refined (in Bond) in the United Kingdom	225,250	218,592	217,752
Raw	39,027	29,918	19,652
Total of Sugar	350,423	322,142	322,266
Molasses	1,652	2,013	2,406
Molasses, manufactured (in Bond) in United Kingdom	13,341	14,460	15,216
	365,416	338,615	339,888

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1924.

	1922. Tons.	1923. Tons.	1924. Tons.
Refined in Bond	31,350	68,900	61,300
Foreign Refined	12,350	22,750	46,550
„ Unrefined	169,800	185,600	156,450
	213,500	277,250	264,300

United Kingdom Monthly Sugar Report.

Our last report was dated the 12th March, 1924.

The market as a whole has been a declining one during the period under review. There have been many violent fluctuations but generally prices for actual sugars have fallen about 3s. per cwt.

The terminal market continued to droop from lack of support. Speculators were more inclined to liquidate their commitments, and big realizations took place. March continued to be well held, and altogether 23,000 tons were tendered on this delivery. March sold from 33s. 6d. to 31s., April from 32s. 6d. to 30s., May declined from 31s. 9d. to 28s. 6d., subsequently recovered to 30s. 7½d. but relapsed again to 29s. 6d., August fell from 29s. 6d. to 26s. 6d., recovered to 28s and relapsed again to 26s. 9d. A good business has continued in new crop, and October/December sold from 24s. 9d. to 23s. 3d. up to 24s. 3d., and November and December from 24s. to 22s. 6d. to 23s. 6d. The latest prices are: April, 30s. 6d.; May, 29s. 6d.; August, 26s. 6d.; October/December, 23s. 6d.; December, 22s. 9d.

Trading in actual sugars has been very dull. The possibility of German exports to the U.K. became very remote in consequence of the price in Germany rising above the world's parity, but traders have continued their hand-to-mouth policy in the hope of a reduction of the sugar duty in the Budget, which is to be taken on the 29th April.

The British refiners have made a series of reductions, viz.: 1s. on the 13th March, 1s. on the 18th March, 1s. on the 27th March, and 1s. on the 4th April. From this level they advanced their prices 6d. on the 7th April, and their to-day's quotations are No. 1 Cubes 63s. 6d., London Granulated 60s. 7½d.

The refiners in consequence of the very poor demand for refined have not been very keen buyers of raws, and only small sales have been made at declining prices. Some Cubans and San Domingos were sold at one moment as low as 26s.

Foreign Refined has not been very active and only a comparatively small business has been done. Navigation on the Elbe is now officially open and, although good quantities of Czecho Sugars have become ready at Hamburg, only a small proportion of this sugar has arrived in the U.K. owing to difficulties of shipping. Czecho Granulated has been sold from 33s. 9d. down to 30s. for various deliveries up to June, but has recovered to 30s. 9d. Dutch Granulated has been sold in small quantities from 34s. 6d. to 31s. 6d. and has always commanded a higher price than Czecho Granulated owing to the better shipping facilities. Belgium Crystals have also been sold in small quantities from 34s. to 31s. ready f.o.b. Antwerp. May/June Javas have been traded in from 28s. 9d. to 26s. 3d., and June/July from 27s. 6d. to 25s. Spot Javas—which are very tightly held—sold from 61s. to 58s. 6d. duty paid, and Fine Granulated on the spot from 62s. to 59s. duty paid. American Granulated is still too high to compete with Continental Sugar. A fair business has been done in new crop Continental Granulated, Czecho Granulated sold from 25s. down to 23s. 6d., and Dutch Granulated from 25s. down to 23s.

The market in America has been one of the chief causes of the decline in the European markets. The demand for refined in the U.S. has not been up to expectations, and in consequence of large arrival of raws from Cuba and the refiners pursuing a holding off policy prices sagged. Large sales were made on the futures market and violent fluctuations ensued. Cuban raws fell from 5⅜ cents to 4¾, and up again to 5 cents c.i.f., and the latest price is 4¾ cents again. It has been reported that large short sales have been made on the futures market in New York on account of Czecho Slovakia and Java. These sales are variously estimated to be anywhere between 100,000/200,000 tons.

The Cuban crop appears to be progressing satisfactorily, and up to the present the receipts at the ports are 2,321,809 tons against 2,244,391 last year. So far neither Guma nor Himely see any reason to alter their estimates.

With regard to the European beet crops, Mr. F. O. Licht estimates a probable average increase of 20 per cent. in the 1924 sowings but, of course, at the present moment it is far too premature to give any reliable estimate.

21, Mincing Lane,
London, E.C. 3.
12th April, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
SUGAR JOURNAL.

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No. 305. MAY, 1924. Vol. XXVI.

Notes and Comments.

The Labour Budget.

The first Budget proposals of the Labour Government in this country reveal no revolutionary changes; it has turned out the sort of measure that might have been expected from a Liberal, if not a Conservative, Government of twenty years ago. An attempt has been made to reduce taxation, and nearly all classes, except the actual income-tax payers, have received some small measure of relief. The greatest alleviation has, however, been reserved for the consumer of food who has in the recent past been taxed to an admittedly excessive extent. He will now be asked for some 28 millions less per annum. Unfortunately for the sugar-producing industry of the Empire, nearly 18 millions of this is to come off the sugar duty, since Mr. Snowden, the Chancellor of the Exchequer, has decided to reduce this tax by more than half—that is, for sugar exceeding 98° polarization the duty is cut down from 25s. 8d. per cwt. to 11s. 8d.; or, per lb., from 2¾d. to 1¼d. Incidentally, the tea duty is halved at an estimated loss of £5,400,000 per annum.

All parties in the House of Commons were agreed that the time was ripe for a reduction of the sugar duty in the interests of the consumer, and Mr. Baldwin last year made no secret of his intention if he were in office this year to so reduce it. But instead of the penny per lb., which was the utmost amount generally anticipated, the Government have decided to take off 1½d., a rather drastic reduction.

At the outset of unfolding his Budget proposals, Mr. Snowden referred to the undertaking given by the late Conservative Government to stabilize the Imperial preference on sugar for a term of ten years and repudiated the suggestion that one Government had any right to bind its successors to perpetuate the custom. At the same time he announced that for the present the Government had no intention of departing from the existing statutory scale of preference, viz., the granting of one-sixth rebate off the sugar duty to sugar produced within the British Empire, though they reserved the right at any subsequent date to review the question afresh. It is also clear from the Financial Statement issued to the House that the remission of all duty on home-grown beet sugar is to continue. So to the extent allowed by the revised scale of duties British beet and cane sugar are to continue to receive a preference.

Where the sting lies is in the fact that by reducing the amount of the duty so drastically, the Government have cut down the monetary value of the preference to an exceedingly small sum; the home beet sugar experiments have to be content with 11s. 8d. per cwt. instead of 25s. 8d. as previously, while the Colonial sugar producer will now get only 1s. 11⅓d. per cwt. or $\frac{5}{24}$ of a penny per lb. This, while "better than nothing," as the saying is, will nevertheless be a totally inadequate amount to ensure a healthy vitality in the respective industries. We regret in particular the reduction of the preference on cane sugar to so small a sum. Had it been stabilized at a fixed sum instead of being a percentage of the duty actually in operation, we might have seen the preference remain at 4s. 3·3d. per cwt. instead of being cut down by more than half. But Mr. Baldwin's Government neglected their chance last year of accomplishing this; and now, we suppose, it is too much to expect that a Labour Government which came into power on what was largely a Free Trade ticket—that is, at an election in which an attempt by one party to introduce protective tariffs generally was defeated owing to the other two parties making an electoral plank of the opposing policy, that of free trade—should stultify itself unnecessarily by improving the incidental operation of a preference duty instituted by its predecessors. And as Mr. SNOWDEN, the Chancellor of the Exchequer, is known as a doctrinaire Free Trader, his predilections would be all against a continuation of the differential duty. So once more the Colonial sugar industry, instead of being placed on a permanently firm foundation, is to be the shuttlecock of contending schools of home politicians. Some day, it is possible, the shuttlecock will come to rest; and there are those who believe that Protection will eventually come to this country under the ægis of the Labour party. The McKenna duties are already a cause for misgiving within their ranks. Conceived originally as emergency duties during the war, to help to economize freight and also to discourage imports of foreign manufactures at a time when it was necessary to keep as much money in the country as possible, they have lived to justify themselves as a decisive aid in expanding the industries concerned[1] in this country, and thereby in employing steadily a very considerable body of workmen at a time when other trades are doing indifferently well. Now when the Labour Government propose to drop these duties at a few months' notice, the volume of protest heard amongst the labour circles affected is big enough to give the Government cause to re-consider their intention. If it be true that the dropping of these duties will throw a large number of men at present in receipt of good wages into the ranks of the unemployed, the Government's concern for unemployment will be portrayed in a rather undesirable light. Personally, we hope these duties will be continued *sine die*, because they are a valuable object lesson to folk at home as to the advantages of protecting certain industries, and they have an indirect influence for good on the policy of securing complete preference within the Empire.

The Home Beet Sugar Industry.

The effect of the reduction of the preference to home-grown beet sugar by 14s. per cwt. is considered a serious matter by those most concerned. Mr. ALFRED WOOD, of the British Sugar Beet Society, is reported as saying that it will mean that any new factories will probably work at a loss during their initial years and the existing factories will receive a serious set-back unless some form of compensation is granted. The farmers too will suffer in so far that the average price they are paid for their roots is based on the average price of the sugar sold. First impressions of pending ruin are apt to be overdone, but it is obvious that the small experimental factories we already possess or contemplate erecting are not the profitable ventures that established factories with a very large output would be expected to be; and when it comes to competition with the huge cane centrals of Cuba and Java, it is fairly clear that even the large-scale American beet sugar factories cannot compete on equal terms. At any rate that is the opinion of so well known an expert as Mr. TRUMAN G. PALMER, the American sugar statistician, a letter from whom on this subject will be found on another page of this issue.

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[1] Motor cars, clocks and watches, musical instruments and cinema films.

It is rather unfortunate that the Government should start their connexion with this home-grown beet sugar industry by knocking off more than half its financial aid. A few weeks ago, Mr. NOEL BUXTON, the Minister of Agriculture, at a luncheon given by the British Sugar Beet Society, Ltd., advanced a number of reasons why the present Labour Government should take an interest in the industry; one of these was its contribution to the wage remuneration of the agricultural labourer. The Government did hope, he said, that there should be success achieved by this venture, on the ground that beet cultivation led to a much larger demand for labour and for winter work and good wages for the labourers than other agricultural schemes. He pointed out that under the Trade Facilities Act, the Government were able to make loans to sugar factories amongst others, and enquiries for assistance towards building such factories in twelve different counties had already been received. He said his Ministry was arranging with the Chancellor of the Exchequer that these facilities should be very considerable; the Chancellor was deeply interested and very sympathetic.

Unfortunately the reduction on the subsidy now announced will prove rather a set-back for the industry, and it may handicap the raising of the private capital for new factories which we assume is a *sine quâ non* to the granting of Government loans.

The Effect on Consumption.

So far we have only considered the reduction in the sugar duties from the point of view of the British producer. As regards the British consumer, however, there seems little doubt that the cheapening of the price of sugar will result in increased consumption which will be all to the good. The world's production will benefit accordingly. But production has not overtaken consumption sufficiently to obviate all possibility that any further increase in consumption will create a comparative shortage and so send prices up. The Government last year refused to reduce the sugar duty on the score that the scarcity of sugar would place the benefits of a reduction in the pockets of the sugar speculators. The present Government has apparently satisfied itself that no such risk attaches to taking the step now. Certainly the world's 1923-24 sugar crop (which includes last autumn's crop of European Beet) will exceed the previous one by a considerable margin; WILLETT & GRAY put the increase over 1922-23 at 1,029,161 long tons. And this year's European beet crop promises to be an increase over last year's; according to Licht's latest estimate of sowings there will be 1,975,000 hectares under roots as compared with 1,633,137 hectares last year, an increase of almost 21 per cent. That is, weather and other circumstances permitting.

In the other pan of the balance we have the increased consumption in this country; a possible big increase in the United States, where in 1923 the consumption dropped by 6·1 per cent. as compared with 1922 which was the high-water mark of sugar consumption in the States—we see no reason why the 1922 achievement should not be repeated within a short period of time; and finally, there is an element of uncertainty making itself present in Cuba where insurrection has broken out in the Santa Clara province in opposition to the existing Cuban Government. It is difficult at the moment to glean from the cabled reports how far it has gone or what chance it has of spreading; but whether it develops sufficiently to gain its political object or whether it retires to smoulder further, there appears some considerable risk that damage will accrue to the sugar industry. Even if the present crop is secured *in toto*, and no factories get destroyed, cane incendiarism, which is no new thing to Cuba, might damage the outlook for the 1924-25 crop. Authentic news as to the real state of affairs will be awaited with interest.

An American View of the Year 1923.

The American Sugar Refining Company's annual reports are always elaborate affairs; and that for 1923 falls no whit behind previous ones in interest. A fifty-two page pamphlet with numerous charts and diagrams relating to sugar, it contains an interesting summary of the sugar year in question viewed from the American standpoint, from which we cull the following.

The year, be it noted, was an unprofitable one for the Company as regards its refining operations, a total of 1,162,000 long tons of raw sugar being melted at a loss of $1,693,070. But thanks to its investments in Centrals Jaronú and Cunagua in Cuba and in certain domestic beet sugar companies, the American Sugar Refining Company received dividends amounting to over five and a half million dollars. The result was a net balance of $865,107 which was carried forward. In 1922, it may be observed, 1,650,000 tons of raw sugar were refined at a profit of $10,083,832.

The year started with a declining market and a limited domestic demand for refined while overseas markets were quiet. The outlook for the refining trade looked reassuring, as there seemed an even balance between production and consumption. Out of this favourable and quiet start there, however, sprang a most sensational year. First came the discovery early in January that the United States had "consumed" 5,092,758 long tons of sugar during 1922; this set the sugar buyers and statisticians busy recasting the effect on supply and prices. If such a demand was real and was to continue, then the sugar budget of the world was temporarily out of balance. Next at the end of January came rumours of disappointing results in Cuba. Europe started buying in competition with America, and soon sharp price advances and fluctuations began to reflect these elements of increased consumption, decreased supply, and active European intervention. Soon speculators were drawn from other markets and the New York sugar exchange began to do a world business in sugar futures. To add to the uncertainty, an official trade bulletin came out from Washington about the middle of February and was immediately interpreted as confirming the view that the needs of the world were larger than the prospective production. Finally came Guma's estimate of a reduced Cuban crop.

No wonder then, in the words of Mr. EARL D. BABST who writes the opening statement of his Company's Report, a housewives' scramble started and retail grocers again were limiting sugar sales to any one customer. The refiners were faced with trade hysteria similar to that experienced in 1920. But raw sugar prices advanced faster than refined owing to the competition of European buyers and the refiners were forced into a large business at little or no profit. Public investigations and court proceedings followed in the belief that speculation had forced up the prices, and the whole culminated in a housewives' boycott which in a way was the outstanding economic feature of the year, for it succeeded in interrupting during the summer the even flow of supplies, thereby throwing greater pressure on the invisible stocks of sugar in the refiners' hands.

Between the scramble and the boycott, the whole machinery of sugar distribution was turned topsy-turvy; there was an enormous demand for sugar with sensational price advances in the early winter, the season of smallest consumption, and a lack of demand with severe price declines in the summer, the season of greatest consumption. The market was meantime affected by reason of various foreign events: for instance, the failure of the British Budget to carry a reduction in the sugar duty, which led to heavy buying in Cuba to fill up the demand created by backward March buying; the under-estimation of the Formosan crop and the over-estimation of Japan's needs which led to Java sugar being re-sold to Europe for July arrival at a price below that of Cuba. The demand in England lessened again in June and with shipments from the far east the British refiners were faced with excessive stocks and American refiners had to bring back their unsold refined stocks, sent to England for the summer jam making. This was the period of low prices in mid-summer.

An entire change suddenly followed abroad with gradually advancing prices but with many fluctuations, primarily caused by the exhaustion of the beet supplies of Sweden and Denmark, which in conjunction with Russia purchased the surplus afloat to England, while India bought Java sugar. Meanwhile during the summer the United States refiners were operating at little more than half their capacity; but reduced domestic supplies in the hands of the trade finally recreated a general demand and with the canning of a plentiful September fruit crop householders began to increase their purchases. Prices rose by the end of September, approaching the high point of the year and with many fluctuations remained at the higher level until the close of 1923.

The year ended, remarks Mr. BABST, with a consumption, so-called, of 4,780,684 long tons and with the complete exhaustion of the Cuban crop and the importation of 168,473 long tons of raw sugar from Peru, Santo Domingo, Brazil and other foreign sources, giving thereby a sensational ending to a sensational year. It was a year in which the forecasts of Washington and of the Cuban statisticians GUMA-MEJER, were confirmed by actual outturn of crops, but a year in which the much heralded "sugar shortage" did not materialize.

The Cuban Properties of the A.S.R. Co.

In Cuba Central Cunagua completed its sixth campaign and Central Jaronú its second in May, 1923. Cunagua produced 588,246 bags and Jaronú 578,390 bags of 325 lbs. of raw sugar each, while the joint production of final molasses amounted to 8,443,475 gallons. These properties have now operated under the conditions both of high and of low price levels and always at a profit. They may therefore be considered as seasoned properties. The results of the 1923 campaign were most gratifying to the owners, both in output, in operations and in profits. At the end of the year there was a plantation railroad system of 165 miles of standard gauge track, including yards, spurs and sidings, with 17 seventy-five ton oil burning locomotives, 6 steam-pressure yard locomotives and 600 thirty-ton steel cane cars. During the year 520 caballerias (33¼ acres each) of land were purchased, making, exclusive of Cayo Romano and Cayo Cruz, a total of 9,624 caballerias of land owned and 720 caballerias of land leased. The major portion of the whole track is virgin cane land, thus insuring for many years to come sufficient cane land for the requirements of the two factories. At present 600 caballerias of this virgin cane land are under development and will yield additional cane for the 1924-25 campaign.

Great credit in the opinion of Mr. BABST is due to the Cuban organization, administrative and colono, for the results of the 1923 campaign. Its fine spirit and courage following the Cuban crisis of 1920-21 made these results possible. Not only were the field cultivations at Cunagua maintained at their customary high standard, but at Jaronú 40,000 acres of forests were turned into cane fields.

The Gray's Inn Central, Jamaica.

From Mr. FRANK P. RUDDER, M.I.Mech.E., advising engineer to the firm of Henckell, du Buisson & Co., we learn that the Gray's Inn Central Factory, Jamaica, which got into financial difficulties at the outset of its career, has lately been taken over by his firm, and Mr. RUDDER has been busy organizing it and putting it anew into operation.

His opinion of the factory is expressed as follows:—"It is a splendid plant, a 30 in. × 60 in. 14-roller electrically-driven outfit. The only steam unit in the factory is a Weir steam boiler-feed pump for use when the electrically-driven, turbine type, feed pump is not available, as when the power-house is closed down. The factory is running splendidly. This week's average grinding has been nearly 35 tons of cane per hour, the sucrose in bagasse being 2·66 per cent., and the moisture 46·4 per cent.; our overall recovery (mill and boiling-house) will be quite 86·5 per cent., i.e., per cent. sucrose in juice on sucrose in sugar in sack. This factory does credit to the makers, Messrs. George Fletcher & Co., Ltd., of Derby, and in my opinion is easily the finest sugar factory in the British West Indies and equal to anything in Cuba."

We are glad to give Mr. RUDDER's opinion of this factory because when it first started in 1922, it was not, as we now learn, efficiently handled, and as a consequence some critics were disposed to ascribe its non-operation in 1923 to an admitted doubt in the comparative efficiency of its electrical features, whereas actually financial reasons were at the bottom of the decision not to grind that season. Now that so efficient a supervisor as Mr. RUDDER has taken the factory in hand, we shall await with interest details of the outcome of the first season's operations under his control.

Production and Consumption in British India.

According to *Commerce* of Calcutta, India's production of cane and jaggery during the season 1921-22 which became available for consumption in the earlier part of the year 1922-23 amounted to 2,532,500 tons against 2,448,000 tons in the preceding year. The production of jaggery during the latter year amounted to 2,876,300 tons, and the greater part of it will be available for consumption during the current year. India manufactured 77,628 tons of refined sugar in her thirty-one modern factories and refineries which worked during the season 1921-22, an increase of nearly 4500 tons over the previous year. This sugar became available for consumption during the year 1922-23. India's production of sugar by the indigenous process of sugar-making was not exactly ascertained during the year, but having regard to the general fall in prices of sugar it will be nearer the mark to estimate the production from this source at 40,000 tons as compared with the production of nearly 50,000 tons in 1919-20. We thus arrive at a total production of 117,600 tons of refined sugar during the year. A portion of this sugar is exported by sea to Asiatic Turkey, including Mesopotamia, Persia, Arabia, Ceylon, and Kenya Colony, including Zanzibar and Pemba. There was a considerable fall in the exports to these places during the year, the total quantity exported being only 456 tons, as compared with 1250 tons in 1921-22 and 3614 tons in 1920-21. When the imports of sugar are added to the production and the exports allowed for, the net result for the year under review was to provide some 515,400 tons of white and brown sugar for consumption in India, or 397,800 tons in excess of the production. India has thus still to depend on overseas sources for the bulk of her sugar proper, Java, Mauritius, and Continental Europe being the principal suppliers.

Fifty Years Ago.

From the "Sugar Cane," May, 1874.

W. EATHORNE GILL had a long article in this issue of our predecessor on the clarification of cane juice in general and on the use of his so-called galvanic process in particular. This process was described as depending on the action of galvanism for the coagulation of the albuminoids, pectin and pectates, gum, etc. According to the patent specification,[1] the mill pan was fitted with a sheet of perforated zinc, which fulfilled a two-fold function, viz., the straining of the juice, and the production of a galvanic current, the latter being the result of the action of a composition with which the metal was coated. This composition might consist of a mixture of oleaginous solids or liquids with animal charcoal, metallic sulphides, sulphites, oxides, or basic salts, etc. Ozone was stated to be evolved as the result of the galvanic action, its effect being to bleach the colouring matter of the cane juice with the result that the process was capable of producing a "delicate yellow" sugar, suitable for sale for direct consumption. Much was claimed of this method of working, which, it was stated, had been successfully tried in Demerara, and an extravagant assertion was that the sugar made by means of it contained "the minimum of molasses, if any."

In this issue there appeared a translation of a well-known paper by SCHEIBLER from the *Berichte*, in which he had described the preparation of arabinose from beet arabin, this method of isolating the arabin being briefly as follows: Fresh pulp was freed from juice as much as possible by pressing, and the cake obtained macerated for several hours with alcohol at 86-90°. The extracted mass was introduced into boiling water, and heated for some time, after which milk-of-lime was added to render the solution strongly alkaline, the metarabin thus being rendered soluble. The solution containing the calcium derivative of arabin was separated, treated by carbon dioxide, and filtered, concentrated, re-filtered, acidified with acetic acid, and mixed with a large excess of alcohol, the impure gum thus being precipitated as a ropy mass. It was dissolved in a small quantity of water, and re-precipitated by alcohol, which treatment was repeated several times. Arabinose was obtained from this purified arabin by hydrolysis with acid.

At this time attempts were being made to initiate the cultivation of the sugar beet in Ireland, and the Rev. Prof. JELLETT, the inventor of the polarizing prism, is stated as having "determined the amount of sugar in Irish grown roots by means of his new saccharometer, and found the proportion to vary from 11·02 to 12·59 per cent." Cultivations on a fairly extensive scale had been made at Abbotstown, Co. Dublin, using different kinds of seed, and the results here reported in respect of sugar content and of yield per acre are very satisfactory.

There was a note "On the Sweetness of Sugar" in which Dr. ED. SMITH called attention to the fact that all kinds of sugar have not the same sweetening properties. This was attributed mainly to the source from which the sugar was made, cane sugars being sweeter than those derived from the beet, but it was also considered to be due in part to the process of manufacture adopted.

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[1] English Patent, 2261 of 1872.

The First Labour Budget.

Large Reduction in the Sugar Duties.

The first Budget statement made by a Labour Government in this country was announced to the House of Commons by the Chancellor of the Exchequer on April 29th. There was nothing revolutionary about it; broadly speaking, it was drawn up on conservative lines and was one that pleased the Liberal Party as embodying a good many of their fiscal ideas. As for the Conservative Party, their main criticism was that it did not provide any surplus for contingencies, least of all for forthcoming Labour legislative proposals all of which will presumably involve grants of money. Their strongest opposition was directed at the free trade features of the Chancellor's proposals, which include the scrapping of the McKenna protective duties on certain manufactured articles, and the jettisoning of the proposals for further Imperial Preference, if not of the existing preferences.

The main features of Mr. Snowden's Budget comprise a reduction in certain forms of taxation, mainly indirect taxation. Thus the sugar duty is reduced from 2¾d. to 1¼d. per lb. (that is, for sugar polarizing over 98° from 25s. 8d. per cwt. to 11s. 8d. per cwt.), while tea is reduced from 8d. to 4d. per lb.; and cocoa, coffee, chicory, and dried fruits all receive reductions in the amount of the duties levied on them. These reductions are expected to cost the Revenue nearly twenty-eight millions. Another concession is the abolition of the Corporation Profits Tax which was generally unpopular as being an extra tax on the profits of limited liability companies or rather on their shareholders, and one from which private trading firms were exempt. It was too one-sided in its incidence to be justified otherwise than as an emergency measure.

The debate on the Budget statement lasted three days. Below we give extracts from the speeches made, as concerns the sugar duty and the question of Imperial Preference.

The Chancellor of the Exchequer (Mr. SNOWDEN) began as is usual with an analysis of the revenue and expenditure of the past year and of the year just opened, and then, previous to outlining his taxation proposals, he dealt with the case of Imperial Preference as it is viewed by the present Labour Government. He said :

> "I refer to another important matter, namely, the proposals of the late Government relating to the extension of the present system of Tariff Preference. It will be within the recollection of the Committee that, at the recent Imperial Economic Conference, the late Government submitted certain proposals on this matter, and, as a result of the discussion which took place at that Conference, these proposals were subsequently added to. A pledge was given to the Dominions and Colonies to submit these proposals to this Parliament, a pledge which, in the words of the Prime Minister, "we intend to fulfil to the last letter and to the fullest extent." Subsequently there was an appeal to the country on grounds chosen, not by us, but by the late Government, and during the General Election these proposals for increasing, and adding to, the existing preferences, were brought prominently before the electorate. The result of that appeal is well known, and, obviously, it cannot be ignored. But apart from that, we, on this side of the House, though not for a single moment admitting that we are one whit behind hon. Gentlemen opposite in our desire to promote the best interests of the Empire, have never believed that the interests of the Empire would be best served in the long run by a system of tariff preference, and we have repeatedly expressed those views in this House by our votes on many occasions.

"In these circumstances the Government are unable to endorse the proposals of their predecessors. We greatly regret any disappointment that may be caused to the Dominions and Colonies, but for that disappointment not this but the late Government must bear the responsibility. There is one of these proposals to which I want to make specific reference. The late Government stated that they were ready to guarantee that if the sugar duty were reduced, the preference should, for a period of 10 years, not fall with it, but should be maintained at the present rate of nearly ½d. per lb., that is, so long as the duty on foreign sugar did not fall below that level. This proposal followed a declaration made by Mr. CHURCHILL, when he was Secretary of State for the Colonies in 1922, that for a period of 10 years preference would be continued on the articles then entitled to it. No Government, in our opinion, should attempt to bind Parliament or future Governments for a period of years upon such a controversial issue as tariff preference. The only result could be to raise hopes which are bound sooner or later to be frustrated.

"I think it is important, therefore, to make our position quite clear. We do not propose to endorse or to offer any kind of guarantee in this connexion over a period of years. All that we can say is that, so long as we remain in office, we do not propose, in all the circumstances, to ask Parliament to abolish the preferences now accorded, which, we suggest, should remain on their existing statutory basis. But we wish it to be clearly understood that we reserve full liberty to propose to Parliament, whenever we deem it expedient in the general or financial interest, the reduction or the abolition of the duties on all the commodities to which preference now applies."

After that, Mr. SNOWDEN proceeded to announce his intentions with regard to the food taxes.

"Now I come to the point for which the Committee has waited with such tremendous patience. The Committee will not be surprised to hear that I propose to make some reduction in the Sugar Duty. This Duty, imposed on a prime necessity of life, increased more heavily than that on any other taxed article during the war, is still 14 times above the pre-war rate. In these circumstances, it is my intention to make a substantial reduction in the Sugar Duty. I propose to reduce it from 25s. 8d. per cwt. to 11s. 8d. per cwt. That is from 2¾d. per lb. to 1¼ per lb., a reduction of 1½d. per lb. The reduction will come into operation to-morrow, except in the case of imported goods manufactured or prepared with sugar, and the date in such cases will be 1st July. This, I estimate, will cost £17,700,000 in the current year and £18,400,000 in a full year.

"Mr. BALDWIN a year ago expressed the view that a reduction of the Sugar Duty might not benefit the consumer permanently in the then state of the world market. We disagreed with that view then but however that may be, the reasons which he adduced have less weight to-day because there is every prospect that the latest forecasts will show that the world production will allow for an appeciable expansion of world consumption."

Sir ROBERT HORNE who was the first spokesmen on the Unionist side while congratulating the Chancellor on a Budget that might have emanated from either of the two parties, uttered nevertheless a strong word of protest against the proposed action on Imperial Preference. The Chancellor had, he said, indicated a standpoint with which the Unionists could never agree. It would appear from the action which he took that the only people with whom this country is not to make a trading agreement, lest it brings about a condition of hostility, was our own Dominions. A trading agreement with Russia—yes! But a trading agreement with Australia or Canada or New Zealand was something which Mr. SNOWDEN refused to contemplate. That was not the way to bind the Empire together. One did hope that one of the results of the war was going to be that a new and enlarged view with regard to the Empire was going to be taken in this country, and that we were going to get rid of the old Little England party. But it would appear that the dead hand of COBDEN still held a grip on a considerable number of Members of Parliament. As regards the duties on sugar, tea, coffee and cocoa, we were all, he said, grateful for the reduction. It was an action which all parties would have liked to take at the earliest possible moment. Indeed, it was made plain last year by Mr. BALDWIN that he would have desired at that time to take off a portion of the duty on sugar had it not been for the very peculiar circumstances of the market at that time. There was a shortage on sugar and the chances were that the whole of the remission of duty would have gone into the pockets of the sugar speculators and not into those of the consumer.

Mr. ASQUITH expressed his pleasure at the sound financial lines on which the Budget was drawn. "This is a Free Trade Budget," he said. "There is no doubt about that after the speech we have just heard from Sir ROBERT HORNE. It is a Free Trade Budget both in the manner in which it deals with Colonial preferences and, still more important because it is more significant at the moment, in the manner in which it has dealt with the McKenna Duties."[1]

Carrying on the debate on the third day, Mr. GRAHAM, Financial Secretary to the Treasury, said in the course of his speech:

> "We have made, I agree, a very drastic reduction in the sugar duty from 25s. 8d. per cwt., an incredibly high figure, to 11s. 8d. But, of course, it must be remembered that, taking the figure of 1s. 10d. pre-war, it has been a duty which has been increased beyond all recognition, and it was precisely a sphere in which, when real reductions came to be made, those reductions in order to be expressed in pounds avoirdupois had to be of a sweeping character.
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> "Hon. Members may well ask us what is to be the effect on consumption, and are we sure that a very large reduction of duty of that kind will not so stimulate demand as to defeat the object we have in view and make it easy for rings or corners in sugar supply to manipulate the price against the consumer? In a problem of this character we can, of course, only proceed upon all the information at our disposal. We had the preliminary promise of the trade that if there were a clear cut reduction announced by the Chancellor of the Exchequer it would be put in force at once, and effect appears to have been given to that promise. But beyond that, we must have the figures of the world's supply. The best figure which I can offer to the Committee at the present time is a figure of about 19,250,000 tons for the present year. I think that is sufficient to enable us to say that, even if there be an increase in the consumption, we are probably safeguarded in the matter of balance or carry-over, and can plead with fair force that the situation will not be manipulated against the consumer."

Subsequently, when the Report stage of the Budget resolutions was under discussion, Sir WILLIAM MITCHELL-THOMSON moved two amendments with the object of maintaining the preferential duty on Empire sugar at the existing figure of 4s. 3½d. per cwt. instead of at the reduced rate of 1s. 11½d. and made a spirited plea on behalf of the Crown colonies concerned. He was supported by several other Unionist members, but Mr. SNOWDEN refused to deviate from his set policy, and the amendments were rejected by 243 votes to 182—a majority of 61. In our June issue we hope to give some details of the speeches made in this debate.

The benefits of mechanical tillage are becoming increasingly appreciated in Mauritius, and last year saw a considerable extension in the use of tractors and implements. In this direction lies the best hope of Mauritius countering its chronic labour shortage. The stony nature of the Mauritius soil is undoubtedly a serious impediment, but it has been proved that very unpromising looking land in this respect is susceptible of being cultivated to a large extent mechanically.

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[1] Duties imposed during the war period on imports of motor cars, clocks and watches, musical instruments and cinematograph films; though originally imposed as emergency measures, these have been continued to the present day as the benefit to the trades concerned was too patent to be lightly ignored.

The Wembley Exhibition.

Some Exhibits in the Palace of Engineering.

The British Empire Exhibition at Wembley, which is open from May to October, is such a vast affair (covering as it does over 200 acres) that no cursory inspection of even a day's duration can give even a superficial idea of all its contents. The two largest buildings, the Palace of Engineering and the Palace of Industry, each require at least a whole day's exploration to do them justice. And after that there are some 21 other buildings of lesser dimensions, mostly devoted to the indigenous products of different parts of the Empire, which will attract considerable attention and well repay adequate inspection. As for the Palace of Engineering itself, it covers some 570,000 sq. ft., and is claimed to be six and a half times the size of Trafalgar Square. It is true that for statistical purposes Trafalgar Square is not taken to include the wide streets that bound it and so is not the open space bounded by the building line, but is merely the paved square in centre of which the fountains lie. Be this as it may, the size of this engineering building is such that it can claim to be easily the largest concrete structure in area in the world. Built much on the lines of a modern engineering shop, its roof is at no excessive height, while giving the maximum of light and airiness.

A first visit to this building was made with the object of seeing how far sugar machinery and accessories were represented. It must be confessed that the vast bulk of firms in this country who specialize in that line have not troubled to take space. They may deem that orders in their case are obtained rather by other means and that the cost of exhibiting is not worth their while when the size and nature of their manufactures are concerned. But this argument would apply almost equally to the shipbuilders, who get over the difficulty by exhibiting models. Personally, we think more might be done to exhibit sugar machinery by scale models; one firm, as will be seen below, have resorted to this expedient and we doubt not their models will command the attention of those interested in the subject. But with this exception, sugar machinery is unfortunately not a branch of engineering that the visitor to the Exhibition will easily glean knowledge of, and well staged photographs of existing sugar factory installations that appear on two or three stands will be the visitor's chief impression of the subject.

To come to particulars of individual firms, the MIRRLESS WATSON COMPANY, LTD., of Glasgow, show a 3-roller sugar mill (without engine and gearing), the rollers being of 24 in. by 48 in. dimensions, and being fitted with Hydraulic Pressure Regulators. For Evaporators, this firm resort to some interesting models which show a Quadruple Effect, with the Barometric Condenser added in card diagram. The walls of the Effects are made in part of glass to reveal the interior. There are also models of a Coil and a Calandria Vacuum Pan, likewise with glass sides. In Condensing Plant, this firm also show Steam Ejector Air Pumps, Patent Condensate Pump, Low Lift Centrifugal Pump, 2-stage High Lift Turbine Pump, and a Multiple Jet Condensing Plant.

Messrs. WATSON, LAIDLAW & CO., LTD., of Glasgow, show a battery of three electrically-driven centrifugals of their well known make. These, which are of the type that they supplied to Jaronu, Cuba, are shown on their proper staging with a malaxeur in its usual position above. The baskets are of 40 in. × 24 in., and one is shown with a double lining, while another is fitted with a Roberts-Gibson discharger for second sugars. In one machine the firm's self-discharging basket is fitted.

Messrs. POTT, CASSELS & WILLIAMSON, of Motherwell, Scotland, show a pair of electrically-driven Weston centrifugals with 42 in. baskets, and a pair of water-driven ones with 30 in. baskets, all of their well known type. The electrical machines are of a design that was fully described in our pages about two years ago when illustrating the large Tjomal Factory installation.[1]

The pump-makers are, as might be expected, strongly represented at the Exhibition. Messrs. G. & J. WEIR, LTD., of Cathcart, show specimens of their Direct Acting and Turbine-driven Feed Pumps and of the Weir Multiflow Feed Heater. Messrs. DRYSDALE & CO., LTD., show types of their well known Turbine and other Pumps, including a 6 in. 6-stage Turbine Pump, and a Bon-Accord High Speed steam-driven pump. Messrs. JOHN COCHRANE (BARRHEAD), LTD., stage specimens of a 3-stage Turbine Pump, a 1-stage Centrifugal Pump, and their Clyde Steam Pump.

Messrs. JOHN FOWLER & CO. (LEEDS), LTD., who cater for the big sugar estate, show their latest pattern of 70 b.h.p. steam ploughing engine with winding drum and steel wire rope for working the Fowler cable system of cultivation. With this is staged a 4-furrow anti-balance cable-operated plough. A 30 h.p. self-contained "Agritractor" suitable for ploughing and cultivation and for haulage purposes is shown; and there is also exhibited a 24 in. gauge steam plantation locomotive of the 0-6-0 type, cylinders 8½ in. diam. by 12 in. stroke.

The New Sugar Duties.

The following is the new scale of Customs duties on sugar as proposed in the 1924 Budget; the Preference to Empire Sugar is five-sixths of the full amount, or $\frac{5}{24}$ of a penny per lb. on refined sugars.

					Full Rate of Duty, per cwt.		
					£	s.	d.
Not exceeding	76° of polarization				0	5	7
Exceeding	76 and not exceeding 77				0	5	9·4
,,	77	,,	,,	78	0	5	11·6
,,	78	,,	,,	79	0	6	1·9
,,	79	,,	,,	80	0	6	4·1
,,	80	,,	,,	81	0	6	6·4
,,	81	,,	,,	82	0	6	8·6
,,	82	,,	,,	83	0	6	10·8
,,	83	,,	,,	84	0	7	1·4
,,	84	,,	,,	85	0	7	3·9
,,	85	,,	,,	86	0	7	6·4
,,	86	,,	,,	87	0	7	8·9
,,	87	,,	,,	88	0	7	11·7
,,	88	,,	,,	89	0	8	2·5
,,	89	,,	,,	90	0	8	5·9
,,	90	,,	,,	91	0	8	9·2
,,	91	,,	,,	92	0	9	0·6
,,	92	,,	,,	93	0	9	4·0
,,	93	,,	,,	94	0	9	7·3
,,	94	,,	,,	95	0	9	10·7
,,	95	,,	,,	96	0	10	2·0
,,	96	,,	,,	97	0	10	5·4
,,	97	,,	,,	98	0	10	8·8
,,	98				0	11	8

The old duties which have been in force for five years were given in our issue of May, 1919.[2]

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[1] *I.S.J.*, 1922, 249.

[2] *I.S.J.*, 1919, 212.

Cane Breeding in Hawaii.

Among the various means adopted in these days for obtaining a larger tonnage of sugar cane, perhaps that of raising fresh seedlings deserves to be most carefully considered. It has been shown again and again that by this means a more certain co-ordination of plants and conditions can be attained than by any amount of introduction and acclimatization. Great results have undoubtedly accrued from this latter method: cane varieties and seedlings raised in Mauritius, Barbados, Java, Demerara and other countries, have been spread all over the world, and have in many cases given a fresh impetus to the sugar industry. But it is rare that the ideal cane for any one locality has thus been realized, and we nowhere meet with forms of such wide distribution as the old Bourbon, which presumably was not a seedling, as its reign terminated with and, in a sense, thus inaugurated the regime of the seedling. Whatever may have been the cause of the downfall of that splendid cane, it has practically gone out, and we are more and more dependent on seedling canes; and, moreover, are fast coming to the conclusion that even with these the introduction and acclimatization method is not the best: we must rely more and more on the work being done afresh in each country for itself.

We note from a questionnaire[1] recently received that this fact is being realized in Hawaii, and that seedling work is considered by many planters as the most important problem before Hawaii at the present time. It is of course no new work there, as is evidenced by the sending abroad of such fine seedlings as H 109; but we notice that this variety does not seem to occupy a very dominant position in the islands themselves, and, although introduced to most sugar cane countries, it has not lived up to its high reputation in many of its adopted homes. It is obvious that its success is limited strictly by certain environmental conditions, even in Hawaii, so that it is not to be wondered at that when tried in other countries it has not proved the ideal cane variety sought after. In Hawaii, with the great variations in elevation of the different estates, H 109 is not regarded as in its best surroundings anywhere above 400 ft. above sea level.

It is obvious that, taking the question of elevation alone, the Hawaiian sugar canes are grown in a series of very different environments. Probably a great number of varieties have been found to adapt themselves more or less to these environments, but of the canes mostly grown, we are told that H 109 is restricted to low coastal lands, while Yellow Caledonia, also succeeding there, may be grown up to 800 or 1000 ft.; D 1135 favours the further step from 1000 to 1500 ft., while above the last elevation its place is profitably taken by the "Tip" canes. Elevation is the first important factor to be considered in the raising of seedling canes in Hawaii, carrying with it as it does a number of other factors of equal or minor importance. The relative amount of sun and cloud, the rainfall, the presence or absence of irrigation facilities, the relative amount of heat during the growing period and the character of the soil, vary greatly with the elevation and also with the position of the estates on the eastern or western sides of the islands.

And closely connected doubtless with these is the time needed in the ground for the canes to mature. Here we meet with a matter which might well be considered in any scheme for raising fresh seedling canes. The sugar growing countries may roughly be divided into three separate groups according to this factor. First we have those which may justifiably be termed ill-suited to the best growth of the sugar cane, which have a very short growing period and the impossibility of lengthening it by taking the canes over two years because of the cold weather of winter; such are Northern India and Louisiana, where the actively growing period lasts only from four to six months, from sowing the seed to the cessation of growth, and possibly Argentina. Then we have cases where, while growth almost ceases in the winter, the absence of frosts enables two growing periods to be added together before harvesting the canes; such are Natal, and apparently parts of Hawaii. Lastly we have the mass of tropical countries in which the cane may be planted and reaped at any time in the year, for its growth is not dependent on the limiting factor of heat, but on the amount of moisture available, and the canes are in the ground for about a year; such are the Indian peninsula, Queensland (except in the extreme south), Java, the West Indies, Brazil, Peru.

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[1] A questionnaire on Seedling Propagation, H. F. HADFIELD. Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.

This question of length of time in the ground is rather a mysterious one. One would have thought that it would have been more economical to aim at the one-year crop because of the more rapid turn-over. But the crops reaped in Natal and Hawaii are very large, and in the latter even when divided by two are equal to or even greater than anywhere else. It is a matter of local economics, but we note that there is an apparent tendency even in Hawaii to aim at shorter growing periods. This factor should be held in mind in raising fresh seedlings. For ourselves we cannot help thinking that such a change might be possible if persistently aimed at, provided of course that it can be proved to be an economical proposition. Greater changes than this have constantly been obtained in the case of other crops, and there appears to be no valid reason why it should not be scientifically possible with the sugar cane.

The great variations in climate and soil indicated above suggest that the Hawaiian islands are specially fitted for the foundation of an up-to-date and scientific cane-breeding station. With the exception of the compulsory cessation of growth of the cane owing to frost, it would appear that conditions more or less similar to those of every sugar cane country may be found at some place or other within the borders of the territory; and, with the capital involved in the plantations, the number of scientific experts employed and the well developed spirit of co-operation among the planters, it appears probable that, if this question be seriously taken in hand, a world exposition of this difficult subject may be looked for, the various puzzles of cane breeding solved, and an example set for every country wishing to take up this line of work for itself with the object of increasing the crops of sugar cane grown.

One of the first difficulties to be got over, if it has not already been surmounted, would be the location of the central breeding station. To avoid duplication of effort it should of course be so placed, if possible, as to meet as many of the different sets of environment as can be included in any one site. But this is, after all, not a fundamental necessity, as may be seen from the example set in India, where to improve the class of cane growing in the great sugar tract in the north, the cane-breeding station is situated in the extreme south of the peninsula, and the results appear to be turning out extremely well. The reason for this paradoxical proceeding is however very simple, in that the sugar cane does not normally flower in northern India, and when it occasionally does so the flowers are generally infertile. Besides this, the cold snap in the northern winter would render it impossible to rear the seedlings excepting in a series of glass houses with their attendant inconveniences. All the same, a middle situation is desirable if obtainable in Hawaii, because much of the preliminary testing should be done in the central station, in order to diminish the number of seedlings sent out for more detailed study in the environments for which they have been reared. With unlimited resources it would be tempting to suggest that each of the four islands should have its own station, or again that each dominant elevation should be so provided, but any such schemes, even if economically possible, would entail a great deal of waste of scientific effort in needless overlapping.[1]

This aspect of the question will of course be much simplified by a suitable selection of parents, themselves already acclimatized in the different islands and at different elevations, and the questionnaire shows that this point is being carefully attended to. As the parentage of the seedlings is a matter of fundamental importance, it is well to be quite certain as to what it is, both on the male and female side, and the questionnaire does not give much information as to the local practice. It would indeed almost seem that female parentage is alone rendered certain, for the methods suggested are the old planting of two varieties in alternate rows or placing the desired male parent to the windward of the female. In such cases one could never be really sure that the cross had been actually obtained; but there are already various methods worked out to get over this difficulty, prominent among which is the collection and acclimatization of a set of female parent varieties in which the pollen is habitually sterile or at any rate so as regards their own fertilization. The strictly scientific method of emasculation has been tried (in Barbados for instance) and successfully carried out, but it has led to practically no ultimate results; and anyone acquainted with the character and extreme delicacy of the sugar cane inflorescence will readily leave it out of consideration except as a last resource. A good deal of work appears to have been done on this subject in the Coimbatore Cane Breeding Station, and the raising of canes of definitely known parentage has become a routine proceeding there. If for local reasons the older methods of obtaining seedlings are considered the only feasible ones, large numbers of seedlings will have to be raised with an extended series of selections, and with less prospects of ultimate success.

As is pointed out in the answers to the questionnaire, the importance is recognised of a whole time officer being placed in charge of the work in the central station. It is true that here as in other countries useful seedlings have been raised on different plantations, but for the best results to be obtained a division of labour is desirable, in which the work of the plantations or substations would be confined to the testing of the seedlings sent out after a longer or shorter period of growth and selection; and there will be plenty of this work for the planters to do so in any such scheme. With their detailed knowledge of local conditions, and the commercial characters required, they will be in a much better position to judge of the suitability of any new variety than anyone engaged in the central station in the intensive work of producing the seedlings and making the preliminary selections.

One of the great advantages enjoyed by cane breeders is that, once a seedling has passed its preliminary tests and is put out under crop conditions, it maintains its inherent characters intact because of its vegetative reproduction. There is thus no problem of keeping the strain pure, which entails such a heavy burden of care upon plant breeders dealing with crops habitually raised from seed. In the cotton plant, for instance, not only are there constant variations of small degree from the type in each succeeding crop, but the intercrossing of these in the field may or may not emphasize these variations. And, further, there is a permanent danger of the origin of chance hybrids, through insect agency between the new type being introduced and the standard cottons of the tract which it is intended that it should replace. A complicated system of line breeding, mass selection, roguing, any or all of which may have to be employed according to circumstances, must be kept up until there is no other form grown in the tract; and even after the type dominates completely a permanent station must be kept up for maintaining the purity of the stock from its own inherent variation, which after all was responsible in the great majority of cases for its origin. This necessity is now widely recognized, and a special campaign is being conducted in the United States for the institution of what are called "one variety cotton communities." It is at length realized that the constant deterioration of the new forms introduced is primarily, at any rate, owing to the intercrossing going on in all cotton fields, whether of mixed varieties or of the seedlings of the same variety even when it is of a high degree of purity.

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[1] Since writing the present article, further information regarding the seedling work in Hawaii has come to hand, and this will be referred to in our next issue.

In spite of this advantage of the sugar cane, there is a widespread belief that all new varieties of cane tend to run out after a longer or shorter period of popularity; and the history of every sugar country could provide a number of cases in point. But this matter is by no means cleared up, and somewhat urgently needs a fuller investigation. A number of explanations have been offered by various authors of this supposed tendency in the sugar cane, the so-called *deterioration* of new cane seedlings, but none of these appears to be altogether satisfactory. If it is really inherent in the sugar cane, it may be owing to the fact that the added vigour obtained by crossing a plant which for long periods is grown by vegetative multiplication, disappears far more gradually than is usually supposed; but it is far more likely that such cases as are quoted may be due to a less careful selection of land or attention to the cultivation of a variety once it has been generally accepted and is grown over large areas. This question of running out has a very direct influence on the cost of maintaining a plant breeding station, for it is generally laid down that such a station must be on a permanent basis, so as to be able constantly to produce new varieties to take the place of those degenerating in the normal course of their existence. And, such being the case, it is specially desirable that new information should be gathered on the subject in order if possible to gradually decrease the heavy current expenditure of upkeep. The secret may lie in the fact that, in the past, every effort has been made quickly to get out to the cultivators any kind that has been proved in its preliminary tests to be superior to the standard kinds grown; and this may really mean that the testing period has been too short. But it is obvious that there is a good deal of work before any breeding station which can be provided with the necessary equipment to solve its many problems, both local and of general application.

Much interesting information regarding Hawaiian opinions on these subjects is contained in the various answers to the questionnaire under consideration, but it is not possible to deal with these in the present article. A detailed analysis is given of the good and bad qualities of the existing standard canes grown at different elevations, especially as to their suitability as parents for new seedlings. There is no question that one of the first duties of a station will be to increase its stock of parents, but there is no information as to how far this has been attended to. It is, however, important that, if the full advantages of such introductions are to be gained, they should undergo a period of acclimatization before they are thus used—which means that progress, to be sure, must be at first somewhat slow. The ideal characters of the seedlings to be aimed at are also given in considerable fullness, although this is undoubtedly influenced in many cases by the particular environment of the planters from whom such ideals emanate. Thus great variations of opinion are seen regarding the desirability of broad and narrow leafed seedlings, thick or thin canes, erect or procumbent varieties especially with regard to weed control, colour of canes in relation to richness of juice, growing period and time of flowering, age at which a seedling should be given out, the number of selections required, slow or rapid germination as indicative of inherent vigour, ratooning power, and so on. The paper will be of interest to all workers in this line of cane improvement, and the subject will doubtless receive a considerable amount of attention in the Sugar Section of the coming Food Conservation Congress at Honolulu.

C. A. B.

The Straining of Raw Juice.[1]

By S S. PECK and E. W. GREENE.

INTRODUCTION.

The present practice of straining raw mill juice consists in passing it through perforated metal strainers which catch the larger particles, removing them by scrapers and carrying them back to the mill. The object of this straining is to remove such particles as will interfere with the work of the pumps and distributing systems of maceration. The size of screen opening varies widely in different factories. It is generally stated in terms of the number of openings per sq. in., and ranges from 72 to 225. These are controlled by the width and length of the strainer, the rate of travel of the scrapers, the variety of cane ground, the condition of the returner bars and grooves, and the quality of the preparation of the cane and milling. Such a system makes no pretence of removing all the suspended matter, which amounts to from 0·3 to 0·7 per cent. dry matter on juice. This consists of broken cane fibre, fine trash fibre, and the dirt and soil brought to the mill on the cane. The presence of some cane particles has been found necessary to insure a press-cake that will filter well and wash rapidly. In fact, instances are known where the size of the openings has been increased because of this reason alone.

In several reports of this Association and of the Hawaiian Sugar Planters' Association the views have been quoted of several writers, stating the desirability of replacing this part of the milling equipment with something better, not only because of the mechanical difficulties arising from broken chains, broken screens, etc., but principally because this station is a breeding place of infection and fermentation of the adhering cane particles, whence contamination of the whole juice is aggravated. Steaming the upper surface of the screen, chains and slats reduces this danger considerably, but the lower surface of the screen is not reached and presents a large and growing bacterial population to the juices passing through.

With a view to removing further amounts of suspended matter, finer perforated screens have been tried on the mill strainer, up to 625 openings per sq. in. Trouble usually followed due to particles of "cush-cush" being forced by the rubbing action of the scrapers into the openings and eventually reducing the straining area. This could possibly be corrected by using woven wire screens with the same size opening and presenting a much greater straining area, but these are impracticable where the accumulated material has to be removed by such a means as the scrapers. Trouble also developed at the filter-presses which reflected the absence of the filter-aid of the fibre particles in size between the 625 screen and the larger mesh.

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[1] Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 22nd, 1923.

Among the remedies suggested for the defective quality of Hawaiian raw sugar from the refining point of view is the fine straining of the raw juice. That is, it would appear that if this juice were freed of the greater bulk of its suspended solids before liming and heating, it would give a clearer clarified juice and also a cleaner sugar. The theory was that in boiling this material in sugar liquors in the presence of lime, there was either a solution of certain components of the cane fibre or a hydrolysis of some of the constituents into soluble compounds. Several laboratory tests have shown that boiling juice in the presence and absence of matter which can be removed by straining through a fine mesh screen shows decided differences. Without straining, the resulting clarified juice had a lower purity and contained a larger percentage of solubles precipitable by alcohol than was the case with the strained juice. Later investigations have shown that such dissolved impurities do not play a very important rôle in causing poor filtering sugars, although they contribute to it. But it has also been found that fine straining before liming and heating does improve the filtrability of the resulting syrup, due to a reason brought out in Mr. Smith's report on this subject.[1] One experiment gave the following results:—

	UNSTRAINED.	STRAINED.
Purity	86·7	87·7
Filtration rate of syrup	40·0	49·0

TYPES OF STRAINERS.

Four types of strainers have been brought to your attention, three of which have originated in Hawaii. The Carter defecated juice strainer was intended originally for the treatment of clarified juice, as the name indicates, and was later tried on raw juice. It consists of three inverted conical screens, one above the other, mounted on a vertical, rotating shaft, the whole enclosed in a steel plate housing. This apparatus was installed at Waipahu early in 1923 for trial in screening raw juice after it passed the regular mill strainers. The Carter strainer did not operate successfully under these conditions and it was removed from the Waipahu mill.

An inclined juice screen operating by gravity and without moving parts has been in use during all of the 1923 crop at the mill of the Oahu Sugar Company, Waipahu. The screen frame is set at such an angle that when raw juice is distributed at the top of the incline it will pass through readily at the same time, washing the separated suspended solids gently towards the lower end of the screen where they discharge. During this year the fineness of screening was limited by certain features of the mud station. However, with 50-mesh screen there was a separation of 70 to 75 per cent. of the suspended solids. The "cush-cush" was discharged in satisfactory condition without excessive dilution. Changes are now being made in the mud station and it is anticipated that next year either 80 or 100 mesh screen can be used.

At Kahuku a revolving juice strainer has been in operation all season. During the early part of the crop only half the juice was strained, so as to allow some bagacillo for the presses. Since July 5th all the juice was strained. This strainer was also put in at the factory of the H. C. & S. Co.

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[1] *I.S.J.*, 1924, 181,

The Straining of Raw Juice.

At Puunene all the juice from the crushers, first and second mills of the two tandems was taken care of by a 6 ft. strainer. This amounted to about 19,000 gallons of juice per hour. The machine was a little crowded; it would be safe to say that the capacity is 16,000 gallons per hour.

MATERIAL REMOVED.

In an installation at Los Mochis, 75 per cent. of the suspended solids was removed by a strainer covered with an 80-mesh screen, the suspended solids dropping from 0·4 per cent. to 0·1 per cent. of juice. At Puunene it amounts to a similar quantity, being about 0·3 per cent. of the cane. On a crop of 200,000 tons of cane this would be equivalent to 1000 tons of bagasse of 42 per cent. moisture, or a direct fuel saving to that extent.

Because of the straining action of the bagacillo itself, much material smaller than the screen openings is taken out of the juice. In one test at Kahuku it was found that of the dry matter removed from the 100-mesh screen, 50 per cent. was smaller than this sized opening. It was an occasion of very dirty cane, and the bagacillo discharged from the strainer was chocolate coloured.

QUALITY OF JUICES.

The change due to the elimination of this matter on the quality of the juices was particularly noticeable at Puunene. The Dorr clarifiers had already made for a very much improved condition of the juices over previous years, but after the juice was fine strained a further very decided improvement resulted. The syrup from these juices was now clear and brilliant. It had a filtration rate at least 50 per cent. better than syrups from adjoining factories. A sugar made from this syrup, straight strike, and washed, gave a filtration rate of 116; the same unwashed was 100, and from a mixed strike 100·8. The turbidity of the sugar was 68 washed, 45 from the regular strike, and 28 from another factory doing usual work. At Kahuku since July 5th and thereon to the end of the crop, all the juice was strained. There was an immediate improvement in the quality of the liquor, which was later shown in the sugars. They were able to carry a higher alkalinity than formerly, and had no trouble in the settling tanks as regards rate of sedimentation. There was a congestion here for another reason, which will be described later.

FILTER-PRESS WORK.

At Puunene under the Petree process there was naturally no filter-press problem. At Kahuku, as soon as all the juice was sent through the strainer, there was an immediate response at the presses, the juice and mud spurting through the cloths, only a thin film of mud forming before the presses stopped running, and a sludge remaining that could not be sweetened off. This was corrected by liming the settlings to distinct alkalinity, bringing to a boil, after which a perfect cake was formed, the rate of filtration was better than ever before, and the cake could be sweetened off to 2 per cent. polarization in the usual time of washing. On emptying the presses they were found with a full cake at each frame, up to 1¾ ins. thick, with only about 62 per cent. moisture, and so dry that they fell off the cloths readily, leaving clean cloths. Instead of being crowded with five presses, it was found possible at times to do the work with three.

In liming the settlings to this alkalinity, it was not thought good practice to mix the press juice with the clarified juice going to the evaporators, so the press juice was sent back to the raw juice. This additional juice along with the washings crowded the settling tanks, which were rectangular tanks, 4 ft. high, with the lowest draw-off 1 ft. from the bottom. The difficulty was overcome by emptying the settlings after every second fill, that is, the draw-off to the presses amounted to one-seventh of the volume of juice instead of one-fourth as was the case formerly. There was no further trouble; the second settling took place as rapidly as the first. The juices were clean at all times, and the presses were easily capable of handling all the work.

Criticism might be offered toward this practice of high liming the settlings, with the possible effect on glucose and darkening of the juices. No such condition was observed. It is very possible that the time of heating and contact with the high alkaline solution is not of sufficient duration to make for any decided reaction in this respect.

The effectiveness of the straining was shown at Kahuku in two products. The clarified juice was as usual run over a 100-mesh screen, but there was no longer any need for it, as practically nothing was collected thereon. A sample of cake was washed through a 100-mesh screen, and left only 0·28 per cent. dry residue, whereas the ordinary cake showed up to 20 per cent.

A report from Kahuku to the Committee on Boiling-house Methods shows the quality of the work obtained there as regards waste molasses for the 1923 crop. There were possibly several contributing factors to this excellent showing, but it is thought that the remarkably free character of the low-grade products was primarily due to the effect of the strainer.

Calculation of the Economy of Fuel Realized on Drying Bagasse with Flue Gases.[1]

By E. MOOYAART.

At the meeting of the Technical Section held last year, Mr. THILGES made a calculation relating to the advantages to be gained by drying bagasse, but his figures appeared to be too optimistic, being based on experiments made in Germany with certain apparatus. Publication of his remarks was not sanctioned by the Experiment Station. But now the present author submits new calculations, according to which, if a bagasse having 47 per cent. of water be dried by means of flue gases to a material having 15 per cent. of water, an economy of 15 per cent. of fuel can be realized, this calculation being applied to a factory with a grinding capacity of 16,000 piculs (nearly 1000 tons) of cane.

The formula for calculating the heat of combustion of bagasse may be taken as: $V \times 4750 + S \times 3955 - W \times 540$, in which V represents the ash-free and water-free fibre. The composition of the bagasse is assumed to be: fibre, 47 per cent.; sugar, 3·4; water, 46·6; and ash, 3·0. The heat of combustion of 1 kg. of this bagasse is: $0{\cdot}47 \times 4750 + 0{\cdot}034 \times 3955 - 0{\cdot}466 \times 540 = 2115$ calories.

The scheme is that 1 kg. of wet bagasse, having a water content of 46·6 per cent., is taken from the mills, and dried by means of flue gases to 0·628 kg. of "dry" bagasse having a water content of 15 per cent. Thus the water evaporated is 0·372 kg., the calorimetric value being improved by $0{\cdot}372 \times 540 = 200$ calories. Thus the calorimetric value of the 0·628 kg. of "dry" bagasse becomes $2115 + 200 = 2315$ calories.

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[1] Translated from the *Archief*, 1924, 31, No. 4; *Verslag der Vergaderingen van der Vereeniging van Adviseurs bij de Java-Suikerindustrie.*

The composition of this "dry" bagasse is: fibre, 0·47 kg.; sugar, 0·034; water, 0·094; and ash, 0·03. According to Prinsen Geerligs and Bolk, 1 kg. of bagasse having a water content of 46·6 per cent. contains:

0·4569 — 0·4710 × 0·466 = 0·237 kg. of carbon,
0·0634 — 0·0654 × 0·466 = 0·033 kg. of hydrogen,
0·4496 — 0·4636 × 0·466 = 0·234 kg. of oxygen,

to which are added 0·466 kg. of water and 0·030 kg. of ash.

The bagasse would be burnt with an air ratio of 2, which air in Java at 30°C. with a hygroscopicity of 75 per cent. has a composition of 0·231 kg. of oxygen, 0·749 of nitrogen, and 0·02 of water.

1 kg. of C for combustion to CO_2 requires 2·667 kg. of O
1 kg. of H ,, H_2O ,, 8·000 kg. of O
0·237 kg. C + 0·632 kg. O = 0·869 kg. CO_2
0·033 kg. H + 0·264 kg. O = 0·297 kg. H_2O
0·896 kg. O
Subtracting that present, 0·234 kg. O
0·662 kg. O

this amount to be supplied by 0·662/0·231 = 2·866 kg. of air; or 5·732 kg. with an air ratio of 2. Then the combustion gases will have the composition: 0·869 kg. of CO_2; 0·297 of water chemically combined in the bagasse; 0·115 of water present in the air; 0·466 of water present in the bagasse; 0·662 of oxygen present in the excess of air; and 4·293 of nitrogen present in the air; a total of 6·702 kg. of combustion gases.

This bagasse has a combustion value of 2115 calories, of which 0·297 × 540 = 160 calories are used to evaporate the water formed during evaporation, the balance of 1955 calories serving to raise the temperatures of the combustion gases.

According to Dr. A. Lange, the specific heat of CO_2 is 0·2565; of oxygen, 0·2325; of nitrogen, 0·2655; and of water, 0·559. So that the increase in temperature is:

$$\frac{1955}{0{\cdot}869 \times 0{\cdot}2565 + 0{\cdot}662 \times 0{\cdot}2325 + 4{\cdot}293 \times 0{\cdot}2655 + 0{\cdot}878 \times 0{\cdot}559} =$$

$$\frac{1955}{2{\cdot}007} = 975$$

If the temperature of the chimney stack is 250°C., then the boiler and masonry take up: $1955\,\frac{975 - 250}{975} = 1461$ calories, 494 calories going up the chimney.

The composition of the flue gases from 0·628 kg. of "dry" bagasse having a water content of 15 per cent. is: 0·237 kg. of carbon; 0·033 of hydrogen; 0·234 of oxygen; 0·094 of water; and 0·030 of ash; a total of 0·628 kg. The same quantity of air is necessary, and the flue gases now consist of:

0·598 kg. of bagasse (0·628 — 0·03)
5·732 kg. of air
6·330 kg. of combustion gases.

This bagasse converted into combustion gases has a composition of: 0·869 kg. of CO_2; 0·297 of water chemically combined in the bagasse; 0·115 of water present in the air; 0·094 of water present in the bagasse; 0·662 of oxygen present in the excess of air; and 4·293 of nitrogen present in the air; a total of 6·330 kg.

The bagasse has a combustion value of 2315 calories of which 0·297 × 540 = 160 calories must serve for the evaporation of the water formed in the combustion, the balance of 2155 calories serving to raise the temperature of the combustion gases.

At 1170°C. the specific heat of CO_2 is 0·268; of oxygen, 0·236; of nitrogen, 0·27; and of water vapour, 0·582; and the rise of temperature is:

$$\frac{2155}{0{\cdot}869 \times 0{\cdot}268 + 0{\cdot}662 \times 0{\cdot}236 + 4{\cdot}293 \times 0{\cdot}27 + 0{\cdot}506 \times 0{\cdot}582} =$$

$$\frac{2155}{1{\cdot}843} = 1170^{\circ}\text{C.}$$

If the temperature of the flue gases is again 250°C., then $2155 \dfrac{1170 - 250}{1170}$ = 1695 calories have been taken up by the boilers and the masonry, and 2155 — 1695 = 460 calories have gone up the chimney.

From the wet bagasse 200 calories have been evaporated, and with a drying installation having an efficiency of 80 per cent. 250 calories are absorbed from the flue gases, causing them to fall in temperature to 250/460 × 250 = 136°C.

It is seen from this that the bagasse may well be dried to 15 per cent. of water. From the previous figures the increased effect may be reached in another way:

		CALORIES.
Calorific effect of the wet bagasse		2115
With a boiling efficiency of 95 per cent.		1375
Necessary for the evaporation of 0·297 of chemically combined water.		160
Radiation, say 4 per cent.		86
Passing up the chimney		494
Calorific effect of the dry bagasse		2315
Efficiency for boiler, 2315 — 708		1607
Necessary for the evaporation of 0·297 of chemically combined water.		160
Radiation, say 4 per cent...	708	93
Chimney loss, 494 — 0·372 (250 — 25) × 0·47 S W. =		455

It is seen from this that the boiler efficiency has risen with the use of dry bagasse to 1607/2315 = 69·3 per cent., while the efficiency according to mutual comparison has risen to $\dfrac{1607 - 1375}{1375}$ = about 17 per cent. In the financial calculation which follows here an increase of efficiency or economy of 15 per cent. can be accepted.

A factory having about 16,000 piculs (nearly 1000 tons) of cane will yield about 14,000 piculs of raw juice, say with a Brix of 15°, so that daily 12,000 piculs of water are introduced. In a normal factory 200 piculs of dry fuel are burnt per 1000 piculs of water introduced in the raw juice. In the present case, therefore, 2400 piculs of dry fuel, or 2800 piculs of bagasse containing 50 per cent. of water, or 2400 piculs of djatie wood, are used. The dryer and also the mechanical conveyor will demand 1½ per cent. of this, or 36 piculs of djatie wood, so that the economy becomes 300 — 36 = 264 piculs per day.

Assuming a grinding season of 140 days, then the economy is: 264 × 140 = 36,960 piculs of djatie wood at F. 1 per picul, or F. 37,000 in round figures (about £3100), which figures naturally will vary according to the price of the extra fuel. If, for example, cane trash only is burnt the economy in this case becomes: $264 \times \dfrac{4}{2{\cdot}5} \times 140$ = 59,136 piculs at 16 Dutch cents, or F. 9500.

A bagasse dryer and mechanical conveyor, together with the cost of installing, may be fixed at F. 200,000 (about £16,666), while for rent and amortization at 13½ per cent. annually there will be necessary F. 27,000 (about £2250). All these calculations are to some extent approximate only, but each factory will find in them a basis for the estimation for its case of the remuneration of the scheme.

The Effect of Filtration with Vegetable Carbons and "Filter-cel" (Kieselguhr) on the Number of Micro-organisms in Cane Juices and on their Subsequent Rate of Development.

By WILLIAM L. OWEN,
Research Bacteriologist, Sugar Experiment Station, Louisiana.

(*Continued from Page 207.*)

In the next experiment the rate of growth of micro-organisms in juices at 31° C., was compared with the results given in the following table:—

Table IV.

GROWTH OF MICRO-ORGANISMS IN CARBON-TREATED JUICE AT 31°C.

	Original Juice.	Inoc. Ster. Juice.	"Filter cel."	"Darco."	"Norit."	"Suchar."
Original No. micro-organisms[1]	2080	10·4	10·4	10·4	10·4	10·4
Brix	15·28	14·90	14·90	14·90	14·90	14·90
Sucrose	12·80	8·12	8·28	8·44	7·98	8·12
Purity	83·7	54·4	55·5	56·6	53·5	54·49
No. micro-organisms after 41 hours	3880	—	—	—	—	—
Brix	15·28	—	—	—	—	—
Sucrose	12·51	—	—	—	—	—
Purity	81·1	—	—	—	—	—
No. micro-organisms after 7½ hours	10400	—	—	—	—	—
Brix	15·28	—	—	—	—	—
Sucrose	12·96	—	—	—	—	—
Purity	84·8	—	—	—	—	—
No. micro-organisms after 24 hours	15,200	8,520	3,200	15,000	5,200	17,200
Brix	16·74	14·90	14·90	14·90	14·90	14·90
Sucrose	9·88	7·45	8·69	8·40	8·43	8·28
Purity	59·02	50·00	58·3	56·3	55·4	55·5
Average	8·8	3·3	3·2	3·1	2·6	2·9

SUMMARY OF TABLE IV.

Sample.		4-hour.	7-hour.	24-hour.	Increase Acidity. 24-hour.
Original juice	Decr. purity	2·6	—	34·68	7·7
	Incr. micro.	1 : 1·8	1 : 5	1 : 7·3	—
Sterilized inoc. juice	Decr. purity	—	—	4·4	1·4
	Incr. micro.	—	—	1 : 819	—
"Filter-cel"	Decr. purity	—	—	—	1·1
	Incr. micro.	—	—	1 : 307	—
"Darco"	Decr. purity	—	—	0·3	1·4
	Incr. micro.	—	—	1 : 1442	—
"Norit"	Decr. purity	—	—	—	0·6
	Incr. micro.	—	—	500	—
"Suchar"	Decr. purity	—	—	—	1·3
	Incr. micro.	—	—	1658	—

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[1] In thousands per c.c.

The results shown in the above table indicate that the rate of deterioration of the inoculated raw juice was considerably more rapid than that of the filtered juices. This is also reflected in the increase of acidity in the different samples.

In order to test the relative susceptibility of syrups made from juices filtered with the various adsorbents, the juices from one of the previous experiments were evaporated under vacuum to the consistency of syrup. These samples were placed in an Arnold sterilizer, and inoculated with a platinum loop of a torulæ culture; they were then kept in an incubator at 34°C. for one month, after which they were analysed, the following results being obtained:—

Table V.

RATE OF GROWTH OF MICRO-ORGANISMS IN SYRUPS MADE FROM CARBON-TREATED JUICE.

Sample.	Corrected Brix.	Single Polarization.	Sucrose, Clerget.	Purity.	Reducing Sugars.	Acidity, 10 c.c. required c.c. NaOH N/10.	No. Micro-Organisms.[1]
Syrup from raw juice control	67·87	38·4	42·78	63·0	16·9	14·0	—
Do., inoculated	59·70	37·2	39·52	66·1	13·2	18·0	1640
"Filter-cel" syrup, control	69·12	39·8	43·89	63·3	16·8	9·0	—
Do., inoculated	53·99	29·6	29·31	54·28	10·3	13·9	3120
"Darco," control	67·47	42·4	45·25	67·00	16·6	12·0	—
Do., inoculated	53·07	26·8	34·71	65·4	11·2	23·0	3520
"Norit," control	69 92	40·4	44.11	63·1	17·8	13·0	—
Do., inoculated	57·57	38·0	38·43	66·6	6 7	14·5	4440
"Suchar," control	69·61	40·8	45·32	65·1	17·7	14·0	—
Do., inoculated	58·96	26·4	29·66	50·3	10·0	14·5	1140

It will be noted in the above results that the syrups made from filtered juices deteriorated just as actively as the unfiltered sample, and the rate of increase of the micro-organisms was greater in most of the cases. It is apparent, therefore, in the light of these experiments that no special benefits can be ascribed to clarification with adsorbents, in so far as such clarification reduces the rate of growth of micro-organisms as a whole, or as it modifies and redirects such growth into less harmful courses. We have already referred to the benefits that result from any filtration of juice on its keeping quality; and, since the more complete the filtration, the better will be the keeping quality of the juice, then carbon filtration may be amply justified bacteriologically, at least, upon the grounds of its effectiveness in removing micro-organisms. The claims made by CALVERT and KNIGHT[2] regarding the sterilization effects of "Filter-Cel" filtration are not exactly in accord with our results. However, the dissimilarity of our respective plans of experiments renders a definite comparison difficult, if not impossible. The authors referred to obtained their results neither by the determination of the rate of growth of micro-organisms in the treated and untreated juices, nor by the determination of the micro-organisms removed, but merely by comparing the amount of gas given off by the treated and untreated samples when kept in fermentation tubes. Since heat was used in both cases, the results would seem to establish the fairly obvious fact that heat and filtration result in the removal or inactivation of a larger percentage of the micro-organisms originally present in a liquid than can be accomplished by heat alone.

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[1] In thousands per c.c. [2] *Loc. cit.*

THE AMOUNTS OF FORMALDEHYDE NECESSARY FOR THE PRESERVATION OF CARBON-TREATED AND UNTREATED JUICES.

In view of the fact that it is often necessary to preserve juices during brief intervals in factories, as a result of breakdowns or enforced suspension of operations for miscellaneous causes, the rational use of antiseptics in the sugar-house is of great economic importance. Formaldehyde is almost exclusively used for this purpose, the amounts recommended by SPENCER being 3 c.c. per cub. ft. for juice clarified by the sulphitation process, and from 6–8 c.c. for juice clarified by other methods. It is claimed that this amount of formaldehyde will preserve juices for 36 hours. It is of interest to determine whether juices clarified by

Table VI.

Sample.	Brix.	Sucrose.	Purity.	Acidity.	No. Micro-Organisms.[2]	Decrease Purity.	Rate Increase No. Micro.
Original raw juice	12·61	7·90	62·6	3·7	4,240	—	—
Raw juice after 24 hours.	13·79	5·79	41·9	9·1	106,000	20·7	1 : 25·5
Raw juice formaldehyde.	13·09	6·73	51·4	7·9	152,000	11·2	1 : 35·5
Sterilized juice, control	13·80	7·79	56·4	2·1	—	—	—
Sterilized juice, inoculated after 24 hours	14·80	6·05	43·2	3·3	4,840	13·2	1 : 228
Sterilized juice + formaldehyde, 24 hours	14·80	7·9	56·4	3·6	160·6	—	1 : 7·5
Filtered juice, control	15·68	8·28	52·8	2·4	—	—	—
"Filter-cel" juice, inoculated 24 hours	15·68	7·74	49·3	2·45	2,080	3·5	1 : 98·1
"Filter-cel" juice + formaldehyde	15·68	7·68	48·9	2·75	116	3·9	1 : 5·5
"Darco" juice, control.	15·71	8·64	54·9	2·3	—	—	—
Do. 24 hours.	15·71	8·22	52·3	2·9	10,640	2·6	1 : 501
"Darco" + formaldehyde	15·71	8·51	54·1	2·0	196	0·8	1 : 9·3
"Norit" juice, control	15·11	8·79	58·1	2·4	—	—	—
Do., inoculated 24 hours.	15·11	7·90	52·2	3·0	7,200	5·9	1 : 339
"Norit" + formaldehyde, 24 hours	15·11	8·06	53·3	2·3	125	4·8	1 : 5·9
"Suchar," control	15·11	8·87	58 7	2·0	—	—	—
"Suchar" juice, inoculated 24 hours	15·11	8·06	53·3	2·4	11,280	4·3	1 : 532
"Suchar" + formaldehyde, 24 hours	15·11	8·06	54·3	2·3	125	4·3	1 : 5·9
Original raw juice, 72 hrs.	10·26	0·67	6·5	26·3	20,000	56·1	1 : 4·9
Original raw juice + formaldehyde, 72 hrs.	8·91	—	—	18·8	16,000	62·6	1 : 3·9
Ster. raw juice, 72 hrs.	13·09	6·90	52·7	8·6	9,200	3·7	1 : 433
Sterilized juice + formaldehyde, 72 hours	13·09	6·96	53·1	10·1	10,520	3·3	1 : 496
"Filter-cel" juice, 72 hrs.	14·44	6·93	47·99	3·0	640	4·81	1 : 301
"Filter-cel" juice + formaldehyde, 72 hours.	14·44	5·43	37·7	4·3	560	15·1	1 : 260
"Darco," 72 hours	14·51	7·23	49·8	7·5	13,480	5·1	1 : 635
"Darco" + formaldehyde	14·51	6·36	43·83	5·2	3,320	11·07	1 : 157
"Norit," 72 hours	15·11	6·20	41·03	7·1	7,840	17·08	1 : 369
"Norit" + formaldehyde	14·51	6·01	41·4	6·1	2,640	16·7	1 : 124
"Suchar," 72 hours	14·51	6·3	43·48	7·6	12,520	15 22	1 : 590
"Suchar" + formal'hyde	14·51	6·3	43·48	5·4	14,000	15·22	1 : 660

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[1] Spencer's "Handbook for Cane Sugar Manufacturers."

[2] In thousands per c.c.

carbons will differ materially from raw juice in the amount of formaldehyde required for their preservation. In order to test this point, carbon-treated and untreated juices were given additions of formaldehyde equivalent to 3 c.c. per cub. ft. They were then inoculated as in the previous experiments, and placed in an incubator for further observation. The results are given in Table VI.

It is interesting to note that the addition of the formaldehyde proved effective in preventing deterioration during 24 hours only in the cases of the inoculated raw juice and the "Darco" sample. In some of the other cases it greatly retarded deterioration, as in the case of the original raw juice, or actually appeared to hasten it in the case of the "Filter-cel" sample. At the end of the 72-hour period the formaldehyde had in almost every case lost its effectiveness, with the result that the treated samples had, in many cases, deteriorated more than the untreated. This is no doubt due to the stimulating action of the toxic substance in accordance with the biological law first proposed by ARNDT[1] regarding the stimulating action of sublethal doses of toxic substances. It would appear that it may not be rightfully claimed that carbon-treated juices differ very materially from raw juices in their inherent requirements of formaldehyde required for their preservation. And although the amount of the infection of the samples used in these experiments was equivalent to 0·5 per cent. of raw juice, which is perhaps much greater than any to which they would be subjected in practice, still that should not alter their comparative reactivity towards the infection in the presence of the amounts of formaldehyde used.

THE COMPARATIVE RATE OF GROWTH OF MICRO-ORGANISMS IN THE JUICES OF NORMAL, BURNT, AND FROZEN CANES RESPECTIVELY.

The study of the rate of growth of micro-organisms in unfiltered and filtered juices suggests the extension of these studies to include the juices from burned and frozen canes. In Cuba the increasing prevalence of burned canes has furnished rather perplexing problems to sugar manufacturers; and, in Louisiana, periodically at least, we have the problem of frozen cane to vex us. It is of some considerable economic importance therefore to determine the essential differences in the rate of deterioration of juices from sound cane, and from cane injured by these causes. BROWNE[2] conducted some experiments on the relative susceptibility

Table VII.

DEVELOPMENT OF MICRO-ORGANISMS IN JUICE FROM FROZEN AND HEATED CANES.

	Heated Cane.	Frozen Cane.	Control.
Original No. micro-organisms	1,720,000	2,920,000	3,700,000
Original Brix	15·57	15·67	15·07
Original sucrose	9·17	11·4	10·94
Original purity	58·8	72·7	72·00
After three hours	3,200,000	2,800,000	2,400,000
After six hours	5,200,000	4,800,000	4,240,000
Brix	13 99	15·29	15·07
Sucrose	9·27	11·4	10·8
Purity	65·5	74·0	71·0
24 hours	20,000,000	80,000,000	96,000,000
Brix	13·99	15·29	14·47
Sucrose	9·2	10·38	8·77
Purity	66·0	67·8	60·6

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[1] *Biologische Studien. I.*

[2] "Sour Cane in Louisiana," *Eighth International Congress on Applied Chemistry*, **25**, 531.

of juices from sound steamed and frozen canes to the development of micro-organisms, and found that the essential difference was that in the juice from sound cane the development of micro-organisms underwent an initial period of depression, while in the juices from damaged canes, the development was constant from the beginning.

In order to test this point further, and to correlate the bacteriological with the chemical phases of the problem the following experiment was conducted: Twenty stalks of cane were divided into three portions; each of which was taken and cut into short sections, which were tied into bundles. One of these bundles was placed in a steam sterilizer and subjected to a temperature of 220°F. for 30 mins.; while the second portion was immersed in water in a metal container which was packed in a larger bucket filled with a freezing mixture of ice and salt. The canes were subjected to this treatment until the water in which they were immersed was frozen. The three lots of canes were then ground in a handmill, and samples of the juice analysed and set aside for further observation. The results of the experiments are given in Table VII.

The results shown in the above table confirm those of Browne, as regards the development of micro-organisms in sound and heated canes. In the juice from the frozen cane, there is an initial period of very slight depression; or, since the numbers of micro-organisms at that stage so nearly approximate to the numbers at the beginning, we might better term it a period of quiescence. Apparently the temperature was not sufficiently low to completely inactivate the bactericidal substances contained in freshly extracted juice.

If we examine the chemical data given in Table VII, we do not find any very convincing evidence that juice from damaged canes is more susceptible to a rapid rate of deterioration than that from sound cane. If we take decrease in purity as a criterion of the degree of deterioration of a juice, then the normal juice would seem to have undergone the most rapid decomposition of any of the samples. But it was apparent both from the rate of filtration, and the single polarization, the Clerget, and the ratios, that juices from the damaged canes were vastly inferior from a manufacturing standpoint. In other words, their deterioration would undoubtedly have proved more costly from an economic standpoint during the 24-hour storage period than that of the juice from the sound cane. This brings up the perennial question of what is an adequate criterion of damaged or "sour" juice? In Louisiana every season in which canes are damaged in any portion of the sugar belt during the grinding season, there invariably ensues a controversy between buyers and sellers of cane as to the price that should be paid for it. Cross[1] made a very thorough study of the chemical phases of this subject, and very conclusively showed that both the "acidity" and "purity" criteria were valueless when interpreted indiscriminately, and not in connexion with other physical aspects of the juice. Thus, a dextran fermentation might result in a comparatively small increase in acidity, and an apparent increase in sucrose, and yet the juice might be almost valueless for manufacturing purposes. Conversely, a high acidity might result from the action of micro-organisms upon the reducing sugars exclusively and hence result in an increase in purity, Where dextran occurs the single polarization would give erroneously high sucrose values, while the Clerget values for sucrose in a juice which has undergone levan fermentation would likewise be excessive. It is evident that no single element of the chemical analysis can be used as the criterion of the value of damaged cane for manufacture. Possibly the factor: $\frac{\text{Sucrose} \times \text{Clerget} \times \text{Purity}}{\text{Viscosity} \times \text{Acidity}}$ would give a better index of the manufacturing value of damaged canes than any other relationship, provided that the inversion for the Clerget determination be made by the invertase method, so as to obtain correct values in the presence of levan.

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[1] "Sour Cane in Louisiana." *Eighth International Congress on Applied Chemistry*, **28**, 551.

The possibility of using the number of micro-oganisms in juices as an index of the value of cane for milling purposes, is eliminated by the fact that there seems to be no definite correlation between the quantitative bacteriological analysis of a juice and its prospective rate of deterioration. Indeed some of the low figures obtained on deteriorating juices seem hard to explain in the light of RAHN'S[1] work on the fermenting capacity of the individual cell. However, we may presume that in such cases the chemical analyses are made after the development of micro-organisms has passed the peak, and has already begun to decline.

SUMMARY OF CONCLUSIONS.

(1) The amounts of vegetable carbons and "Filter-Cel" that are ordinarily used in the filtration of cane juices in factory practice remove approximately 99·5 per cent. of the micro-organisms present.

(2) The mere filtration of raw juices through cotton wool removes on an average about 75 per cent. of the micro-organisms originally present.

(3) Vegetable carbons and "Filter-Cel" appear to exercise a selective action on the gum-forming bacteria in juice, and in the filtrates yeast and mould seem to predominate.

(4) For short periods of time the development of micro-organisms appears to be somewhat slower in carbon-filtered juices, than in unfiltered juice, and the relative deterioration seems to follow in the same order. But for longer periods than 24 hours, there is nothing to indicate any advantages of the filtered over the unfiltered juice.

(5) Juices filtered with vegetable carbons and "Filter-Cel" seem to require as much formaldehyde for their preservation as unfiltered juice. This of course applies to conditions where the infection is the same in both cases. In practice the filtered juices would always have a lower initial infection.

(6) Cane syrups made from juices filtered with vegetable carbons and "Filter-Cel" appear to ferment just as readily as those made from unfiltered juices.

(7) The deterioration of juices from sound and damaged canes seems to differ both quantitatively and qualitatively. Damaged canes appear to yield more viscous juices, and the development of micro-organisms in them seems to be constant from the beginning, while the development in raw juice undergoes an initial period of depression.

NOTE:—The writer desires to acknowledge thanks to the Celite Products Company for samples of "Filter-Cel"; to the Industrial Chemical Co. for "Suchar," and to the Darco Sales Corporation and General Norit Company for their carbons for these studies.

The Dutch East Indies, under the new constitution of the Netherlands, have been abolished as a colony of that country and made an integral part of the Kingdom of the Netherlands. There is provision under this constitution for the ruling monarch to submit an annual detailed report on conditions of the government of Netherlands India. All laws adopted by the government of the islands are to be approved by the States General of the Netherlands government.

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[1] *Michigan Technical Bulletin*, No. 10.

Recent Work in Cane Agriculture.

THE STATUS OF ENTOMOLOGY IN PORTO RICO. *G. N. Wolcott. Journal of the Department of Agriculture and Labour, Porto Rico. Vol. VI, No. 2. April, 1922.*

This short paper commences with an interesting summary of the physical geography of the island and the range of the chief crops, leads on to the origin, institution and scope of work of the two Experiment Stations, the Federal Station at Mayagüez in the middle of the west coast, and the Insular Station at Rio Piedras in the eastern half of the north coast; and then outlines the chief activities of the Entomological Department, which, to all intents and purposes, has only existed for the past ten years. The high tide of entomological work was probably reached between the years 1912 and 1914, with C. W. HOOKER and later R. H. VAN ZWALUWENBURG, chiefly at Mayagüez, studying coffee insects; D. L. VAN DINE and T. H. JONES, at Rio Piedras working on sugar cane pests; S. S. CROSSMAN at Aibonito on tobacco pests; E. G. SMYTHE at Guanica on white grubs attacking sugar cane, and later C. E. HOOD and W. L. WOLCOTT collecting their parasites; and, lastly, W. V. TOWER in charge of plant quarantine. "Of these men only the two latter are still in Porto Rico, and this tendency of practically all scientists who have been in the island to remain for a year or two, or three or four at most, leaving before they are much more than thoroughly familiar with it and the problems in their line, is one of the points of greatest weakness in all the research that has been done." In no department has this dry rot of the Porto Rico Agricultural Department been more obvious than in its entomological section. Considering the difficulties encountered, the author is perfectly justified in claiming, as he does at the end, that his summary is a not unworthy record of progress and achievement.

Porto Rico is an oblong West Indian island 100 miles long and 35 wide, consisting of a mass of mountains and a flat rim or shelf of fertile coastal plain. Of the crops grown, sugar cane, which received a great impetus during the recent war, is easily the most important; and most of the coastal region, especially in the south, but also many of the valleys, are under this crop. Tobacco is the second in importance, and the lower slopes of the mountains in the eastern and central sections of the interior are covered with the great white cheese cloth sheds peculiar to this crop. Coffee comes third and is chiefly concentrated in the mountainous section of the western part, but, owing to the present low prices, it is dwindling. The grape fruit; an enlarged and less juicy but extremely refreshing member of the orange tribe, introduced on the north coast by the Americans, remains a steady fourth. Oranges, pineapples, cotton, and coconuts are only of minor importance.

The entomological work on the pests of these crops is dealt with in succession. Of sugar cane the most important is the moth borer, *Diatrœa saccharalis*, and it is noteworthy that the treatment of this world-wide pest in Porto Rico differs radically from that in most other places. As the result of detailed and comprehensive study by the specialists, it has been demonstrated that the following two methods are of use in its control:—(1) The trash of dead leaves and cane residues should *not* be burnt after harvesting the canes. A very large number of counts have been made, and it has been shown that this procedure causes an increase of the pest, for the simple reason that far more of the minute and feeble parasitic egg flies are destroyed than the stronger escaping moths, and the eggs of the latter are thus immunized until the parasites recover their normal numbers.

(2) All the moth-bored sets on the field are *planted*, for it has been found that even a light layer of an inch of soil will trap the emerging moths, which are unable to penetrate the soil. If, as is usual, only sound sets are planted, the bored pieces are left lying, at any rate long enough for the moths to emerge, and thoroughly to infect the fresh young shoots of the succeeding crop. Even the most careful burning of these infected pieces is inoperative, for they must first be dried, and plenty of time is thus allowed for the moths to emerge if anywhere near maturity.

White grub was studied exclusively by SMYTHE for several years, and much light was thrown upon the various species of beetles whose larvæ are known under that name and attack the cane plants, as well as the best means of their control. But, unfortunately, none of the recommendations made are being followed, and even the former collecting of the grubs and beetles has been given up, because of the increased cost of labour in the island. Various other pests are named which are known to do a considerable amount of damage, but in most of them the cost of treatment is no longer a commercial proposition for the same reason. A tribute is paid to the eminent services of F. S. EARLE, who came to the island for the purpose of investigating the mosaic disease of the sugar cane, but whose activities covered a much wider field. The investigation instituted by him as to the transmission of this disease by insects, and carried on by various entomologists, has led to no result. But, in a note, the author refers to CHARDON'S recent discovery that *Aphis maidis* is capable of thus transmitting the disease, when driven temporarily from its favoured grasses on to sugar cane after weeding.

ON SOME ABNORMAL SUGAR CANES. *Thos. Steel. Proceedings of the Linnaean Society of New South Wales. Vol. XLVIII, Part 4, 1923.*

The specimens described and illustrated are part of a collection made during many years, and they are deposited, preserved in formalin, in the Museum of the Botanic Gardens of Sydney. Most of them are the production of seedling canes, as these have been found to be more prolific of abnormalities than have the older standard varieties produced for generations from sets. The author notes the effect of adverse conditions on the length of the internodes, especially drought and cold. In two-year old canes grown in New South Wales, where frosts occur, the part of the cane which is formed during the winter months is readily detected on cutting, because of the shorter joints. Referring to cane varieties raised from seed, attention is drawn to the great variation in the types of buds and the colour of the canes. And also the well known fact is emphasized that the progeny of striped varieties is usually of single colours. In examples of "Fijian wild cane" two colours of stalks are met with "mixed together, plain red and plain yellow, without stripes," but it is not stated whether these arise from the same bud; if so the case would be of considerable interest, as striped parents have been known to produce three differently coloured canes from the same bud, one striped, one yellow or green, and one red. The accompanying Plate shows branching of the stem, egg-shaped joints, multiple buds, joints without buds, zigzag leaf scars, etc.[1]

REPORT OF THE COMMITTEE ON STOCK FEED. *Hawaiian Sugar Planters' Association. For the year ending September 30th, 1923.*

This Report is very short, as the Committee states that it has "little to comment on that has not been covered by previous reports." One or two new feeds seem to have been introduced which may merit a few remarks. The first of these is

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[1] Readers interested in this subject are referred to the works by DEVENTER and JESWIET in Java and BARBER in India for fuller details on these and other abnormalities.

"pineapple bran" and the results of trials are reported to be very promising. Mules took it readily at Hakalau when mixed with half barley. Dairy cattle had coconut meal and pineapple bran in the proportion of two to one, and while not taking to it as readily in the first instance as the mules they consumed all that was placed before them. At the OAHU SUGAR Co. the following was the feed for mules in work and idle in lbs. each day:—

	BRAN.	BARLEY.	CANE TOPS.	MOLASSES.
Working	0·5	14	20	2
Idle	0·35	10	20	2

In the off season, hay for working mules 14 and for idle 9. The result of this feeding is reported as very good.

At KILAUEA SUGAR PLANTATION Co. the principal new food of the year was "soya meal," which was used both in stable and dairy with marked success. This meal cost $50 and contained 41·4 per cent. crude proteid, as compared with barley which cost $41·22 and contained 11·5 per cent. crude protein. The soya meal proves to be a palatable food but should of course be used with moderation, one part being mixed with seven of barley in the stables and with six in the dairy feed. Pigeon pea meal is also used in the dairy, plants and beans being ground up together, and used at the rate of one in four in the dairy ration. The new pineapple feed was also used mixed at the rate of one-third in the stable and one-fourth in the dairy feed. It appeared to be liked by the animals.

An interesting picture is given of a method of weed control along the banks of a concrete lined water channel at Wailuku (Maui), sweet potatoes being planted next to the channel and pigeon peas forming a background further off. This method, besides other advantages, saves much labour in weeding, and provides a useful feed for the farm, some of the sweet potatoes also being sold in the market. A large amount of molasses is used in the stock feed, usually mixed. The pigeon peas are found very satisfactory and are fed in racks, as is also all other green feed, thereby saving a vast amount from being wasted.

REPORT OF THE GOVERNMENT CANE-BREEDING STATION, COIMBATORE, SOUTH INDIA. *For the year ending June, 1923.*

The flowering of varieties was very meagre during the season, thus leaving little choice but of seedling canes in place of the older varieties for breeding purposes. This was probably no disadvantage, for over 40,000 seedlings were thus obtained with fresh parents of a hardier nature than usual. The method of controlling anthesis discovered in 1922 was applied so as to pollinate about half-an-hour before the known protusion of the anthers of the female parent, some of the seedlings showing obvious influence of the male parent. From experience gained it was decided to widen the margin of seedlings sent to north India for trial, the result being that 36 were sent during the year to Bihar and the Punjab, a number nearly equal to all the previous sendings. References are then made to the fate of the Coimbatore seedlings sent north in previous years, but most of this has already been fully reported in the Journal. The following may, however, be added. Very satisfactory reports have been received from the farm at Nawabganj in an important sugar tract in the west of the United Provinces. In a very bad year, when all the fields were badly flooded, with a resulting outbreak of red rot both in the local indigenous cane varieties and certain Java importations, the Coimbatore seedlings displayed a remarkable degree of resistance and vigour of growth. Unfortunately, the demand for seed of these latter was far beyond the power of the station to meet.

Over 220 individual packages consisting of 82 different varieties of canes were distributed during the year, but no exotic canes were introduced from overseas for fear of disease. Among those already obtained, some of the most vigorous and promising have shown suspicious signs of mosaic, necessitating their destruction: among these, H 109 which had grown quite healthily for several years had to be included. The study of the rooting system of the sugar cane was continued, nearly 1000 plants having been grown and examined. For this purpose the common earthenware of the country has proved excellent because of its porous nature, and cylinders of it are placed over one another with wire netting between to retain the roots in position for examination at the end of the growth. A number of experiments have been made on germination of sets with special reference to the dependance of the young plant on the nutriment contained in the set. The sets of certain varieties were found to be able to stand immersion in 20 per cent. commercial formalin in water without losing their germinating power completely; and in other experiments some germinated after steeping in water heated to 140°F. for 15 minutes. Thermometer readings within the sets showed that heat penetrates very rapidly, and these results may be of use in the hot water treatment for insect eggs and fungal hyphae.

IDENTIFICATION OF CANE VARIETIES. *Twigg Smith. Report of the Committee in charge of the Experiment Station. Hawaii Sugar Planters' Association. For the year ending September 30th, 1923.*

The author, who has recently been appointed Illustrator to the Experiment Station, outlines his method of work. This is based on JESWIET's studies on the groups of hairs found in different parts of the cane plant, and chiefly on the foliage and resting buds. Drawings have been already made of most of the standard Hawaiian varieties, such as Lahaina, Yellow Caledonia, Striped Mexican, D 1135, H 109 and many of its seedlings. Pointing out the unreliability of the older descriptions, based merely on external appearances, he hopes to find in this intensive study a sure means of classifying the different varieties grown, as well as to be able to check any new varieties by comparing his drawings and descriptions of introduced canes with those given in their native countries. He also considers that here lies the key to solve the riddles of the parental origin of many of the Hawaiian seedlings, for, with the exception of a recent cross between the Hawaiian Uba (with male sterility) and D 1135, all of the Hawaiian seedlings have been collected from uncaged plants in the field. One of the difficulties of the method lies in the fact that it does not hold good for every bud nor for every stalk in a plant. JESWIET prefers cane stems from four to six months old and chooses non-flowering stalks for examination; but, as it is difficult to decide which stalks are to be non-flowering quite so early, the author suggests that six to eight months will be better for local work. The method is to be taken broadly and the examinations based on a reasonable number of buds and canes. This new work is of very considerable importance and should lead to very valuable results in the seedling campaign which is commencing in the Hawaiian sugar industry.

RESISTANCE TO DISEASE AND ADVERSE AGRICULTURAL CONDITIONS BY HARDY SUGAR CANE TYPES. *H. P. Agee. Ibid.*

The recent collapse of the standard varieties of sugar cane grown in Porto Rico through mosaic and root disease, and the successful introduction of Kavangire (Uba) cane from Tucuman have brought this subject into prominence recently. Earle's list of varieties more or less immune to root disease, in which he singles out Kavangire and three crosses between Java canes and ones from North India, namely P.O.J. 36, 105 and 234, as immune, is referred to; but it is pointed out that the "Uba" cane of Hawaii has not as yet been definitely identified. It was probably received from Louisiana, and both in that place and in Hawaii was known as the Japanese cane. A tribute is paid to the work of KOBUS in introducing the disease-resistant North Indian canes into Java when the local Cheribon was threatened with extinction. The Java seedlings referred to above were all crosses between Cheribon and the Chunnee (an *Ukh* cane) of North India.

The appreciation of Uba is noted in Natal, where it saved the industry, in Porto Rico, where it offered a relief from mosaic and root disease, and at the Cuban Experiment Station, which has distributed cuttings of it throughout the cane growing districts of the island. In Jamaica it appears to be increasing in favour as a "hard boiled" variety which chokes all weeds, is the only cane that can be grown on very bad soils, and is never planted on good soils. In one case of bad soil it yielded a 20-ton crop in the ninth or tenth year; the ratoons are harvested in one year and no cultivation is required or given after the first crop. CALVINO, noting its male sterility, is aiming in Cuba at what he calls a "super-Uba," by crossing it with Crystalina; and this lead has been followed by KUNKEL and KATSUNAI in Hawaii, who succeeded in obtaining five seedlings by crossing it with D. 1135, and one of these crosses, although only a few months old, appears to be of distinct promise.

The author considers that it is not improbable that much of the world's future sugar will be obtained from hardy canes grown with a minimum of care; since under existing difficulties agricultural efficiency ultimately depends on the greatest tonnage per man-day of labour. Such "vigorous-rooted, weed-suppressing, strong-ratooning varieties reduce the cost of production per acre to a very low figure" He regards Uba, however, as merely a temporary expedient until hybrids are obtained between it and the thick canes, so as to combine its resistant and free growing qualities with the sugar producing character of tropical canes. He also refers to the re-habilitation of the Argentine sugar industry by the introduction of P.O.J. 36 and 213, each of which is grown over something like 100,000 acres; the introduction of P.O.J. 36 into Formosa, where it has replaced the standard Rose Bamboo to the extent of 56,000 acres; and the recognition of Egypt that in P.O.J. 105 they have a valuable commercial cane variety.

The rest of the paper is devoted to the awakening of Hawaii to the need of fresh introductions, little interest having been shown in the country in foreign canes since 1906, when a consignment of Fiji varieties was condemned by the authorities. Arrangements have now been made for the importing of canes of recognized value from other countries, and the method adopted appears to be the safest possible. Four kinds, P.O.J. 36, 213, 234, and 979 have already arrived. These were received from Java, with certificates of freedom from sereh and mosaic, by the United States Agricultural Department for distribution to Louisiana and Porto Rico and, on application, Hawaii was also included. They were first grown for one year in the Arlington quarantine house in Virginia, near Washington, and are now in the local quarantine station in Hawaii. After this double test it is expected that they will be passed late in 1924, and should be available for distribution to the planters a year later. The careful descriptions by CROSS of Tucuman of the first three seedlings are reprinted in full in the paper; P.O.J. 979 is now being grown under experimental cultivation in Argentina, and presumably no description of it has yet been made there.

C. A. B.

HERBERT GREEN & Co., Ltd., have commenced the manufacture of industrial and power alcohol, ether and fusel oil, at Salt End, Hull, at works occupying a space of about 15 acres.

Cause of the Difficult Filtration of Solutions made from Hawaiian Raw Sugars.[1]

By WALTER E. SMITH.

This report resolves itself into two main divisions: (*1*) A discussion of the factors found to affect the "filtrability" of solutions of raw sugar; and (*2*) suggestions for the improvement of "filtrability."

LABORATORY DETERMINATION OF THE RATE OF FILTRATION.

In the preliminary work the apparatus devised by R. D. ELLIOTT (of the Californian and Hawaiian Sugar Refining Corporation) gave very excellent results. It consists of a small circular leaf, 4 in. diam., over which is spread a cloth supported by a coarse mesh screen, this leaf being connected by rubber tubing to a large bottle in which the filtrate is collected, and the bottle to a water vacuum pump through a suitable manifold. In carrying out a test, 2000 grms. of the sugar were dissolved in 2000 grms. of water at 25°C., kieselguhr (2 per cent. of the weight of sugar) vigorously stirred in, the solution poured into the filter tank, and allowed to stand without agitation for exactly 2 min. Then the vacuum pump was started, and so regulated as to bring the pressure to 26 in. at the end of 3 min. Using a mercury seal, it was found possible to maintain a constant pressure during the full period of the test. At the end of 30 min., the vacuum was released, and the filtrate collected in the bottle was weighed.

As a standard, the weight of filtrate secured from refined sugar was adopted. On the whole this is a satisfactory basis of comparison, though it should be noted that raw sugars have been tested that gave a rate of filtration higher than the 100 per cent. value thus established. A great many tests were made in the manner described, and from the results it was concluded that when the various conditions were kept constant it was possible to secure figures agreeing within at least 5 per cent.

Having found the operation of the test satisfactory, the filtration characteristics of samples of raw sugars from each plantation in the T. H. were examined, these tests being run in duplicate.

INFLUENCE OF SUSPENDED MATTER ON THE RATE OF FILTRATION.

Several facts were observed suggesting that difficult filtration might be caused by the suspended matter in the solutions of raw sugar, the principal one being that after solutions had once been filtered they did not present any greater difficulty on further filtration than did refined sugar solutions of the same density.

Suspended matter in raw sugar solutions exists in several states of dispersion or disintegration, for example, individual particles of *bagacillo* and suspended particles only visible under the microscope at a magnification of 1000 diams. These larger particles were separated by passing the solutions through a very fine linen filter having interstices measuring from 0·075 to 0·150 mm., and the amount determined by transferring to a tared alundum crucible, washing, drying and weighing. The result obtained was called the "coarse suspended matter." The liquid which had passed through the linen was filtered through a thick asbestos pad in a tared Gooch crucible, which after washing was dried and re-weighed. A graph was plotted showing the relationship between the average of the percentage of fine suspended matter and the rate of filtration, from which it was found that in all but 8 of the 37 samples examined the relationship is in inverse proportion, resolving itself into the following formula: Rate of filtration *plus* 1000 times the percentage of fine suspended matter = A constant (about 115).

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[1] Abridgment of a Report of work carried out by the author at the Hawaiian Experiment Station under the advice and general supervision of a Committee consisting of: W. R. MCALLEP (Chairman) WM. SEARBY, HORACE JOHNSON, S. S. PECK, A. G. BUDGE, W. VAN. H. DUKER, and H. P. AGEE.

Several exceptions were observed to this formula, in which the constants were from 121 to 148. It was suspected that in these sugars were present some substance contributing to the weight of the suspended matter, but not affecting the rate of filtration to the same degree as the rest of it. Therefore, solutions of these sugars were centrifuged in the oil tube of a laboratory machine at 1000 revs. per min., when a small deposit was thrown down, after which it was found that the filtration constant calculated from the fine suspended matter present after centrifuging was in close agreement with the constants for the other samples. With these re-determinations, it developed that in the entire series the maximum constant was 117, and the maximum 105, about 80 per cent. being between 108 and 113. These fluctuations can be principally accounted for partly by the experimental error, and partly by the material thrown down by centrifuging having a different effect on filtrability per unit of weight, varying according to its degree of subdivision. Microscopically, the material thrown down on centrifuging is clearly recognizable as disintegrated cane fibre, with a very small amount of crystalline material, the whole being small enough to pass the linen filter. That remaining in suspension is only visible on high magnification, and has the appearance of clusters of gell-like substance with no definite form or size. The material remaining in the solution after centrifuging was termed "non-settling matter."

A solution of raw sugar, from which all suspended matter has been removed, has the same filtration characteristics as a solution of refined sugar of the same density. This fact, together with the agreement found between the amount of non-settling matter and the rate of filtration leads to the definite conclusion that filtration difficulties are due primarily to this finely-divided non-settling matter.

A study was made of the effect of *bagacillo* in the filtration of raw sugar solutions, using a small filter having 1 sq. in. of surface enclosed in a small shell, in which a constant pressure of 50 lb. per sq. in. could be maintained.

It is evident that the principal action of lime and heat in the refinery process on *bagacillo* is the digestion of gums from the cellular material. It was not possible to study this effect in raw sugar solutions. *Bagacillo* (25 times the normal amount) was added to solutions of refined sugar together with 0·025 grm. of CaO per 100 c.c., digestion being carried on for 1½ hour at 95°C. It was then found that the rate of filtration had increased more than 10 times in three tests, the conditions of which of course grossly exaggerated those obtaining in practice. That vigorous action took place was seen by the amount of colouring matter which was digested from the fibre, while it is certain that soluble gums were formed also. It seemed probable that the *bagacillo* had acted in a mechanical way as an aid to increase the rate of filtration, thus masking the retarding influence of the gums produced. To determine if this was the case, the experiment was repeated, but after the digestion and before the filtration test the solution was strained through a linen cloth, removing thus the *bagacillo*. In this test the rate was not increased, the result being only slightly higher than for a solution of refined sugar of the same density. It seems conclusive from these experiments that the digestive action of lime on fibrous material at high temperature does not extract material capable of retarding the rate of filtration. Further, that the presence of the *bagacillo* is not detrimental, but on the contrary exercises a slightly beneficial influence by increasing the porosity of the kieselguhr.

NATURE OF THE NON-SETTLING MATTER.

That the non-settling matter cannot be gums is shown by work done at Crockett Refinery, when the gum content of the filtered solution was as high as in the unfiltered liquor. Yet the filtration characteristics of the filtered solution are decidedly changed.

Under high magnification the appearance of this non-settling matter suggested that the particles were of a waxy nature, being somewhat globular or gel-like. Since in the filtration tests, it had been retained by the kieselguhr cake, portions of this were extracted with ether. It was thus shown that considerable quantities of ether-soluble wax had been removed from the sugar solutions.

QUANTITATIVE DETERMINATIONS OF CANE WAX IN RAW SUGARS.

Good results were obtained by the following method: 15 grms. of kieselguhr were mixed with water, and poured upon a filter-paper placed in a Buchner funnel, a solution containing 100 grms. of raw sugar was passed through the mat of kieselguhr thus formed, followed by sufficient water to thoroughly wash out the sugar, after which the cake was dried and extracted with ether for 8 hours. At the end of this time, the ether was evaporated in a tared flask, which was dried to constant weight.

Some of the results obtained in this way with raw sugars from different mills in the T.H. were as follows: Pepeekeo, 0·016; H. C. & S. Co., 0·017; Oahu, 0·028; Union, 0·036; Wailuku, 0·047; Hutchinson, 0·056 per cent., the variations being from 0·008 to 0·074 per cent.

Since the suspended particles present in raw sugars consists of: *bagacillo*, precipitated inorganic salts, and cane wax, difficulties in filtration must be due to one or all of these. That *bagacillo* does not retard filtration has been found, while crystalline salts are present in such small quantities that they represent only a small fraction of the non-settling matter. Cane wax is present in suspension in sufficient quantity to equal practically all of it, and non-settling matter and cane wax are therefore practically synonymous.

EFFECT OF THE SAPONIFICATION OF THE WAX WITH LIME.

In dilute alkaline solution the fatty acids of the wax are saponified, forming in the case of lime insoluble calcium soap. The presence of this soap in a solution of sugar retards the rate of filtration.

That such a reaction does take place between the fatty acids and lime was conclusively shown by filtering a refined sugar solution to which had been added some ammonium soap (0·02 per cent. as stearic acid) together with sufficient lime to make it slightly alkaline to phenolphthalein, when it was found as the result of such addition that the rate of filtration was retarded 35 per cent., giving a figure corresponding to that of the best Hawaiian sugars containing about the same amount of ether-soluble fats.

In a number of tests made with different raw sugars, it was observed that the rate of filtration decreased about 25 per cent. by the addition of sufficient lime to change the alkalinity from neutral point to litmus to neutral point to phenolphthalein, or to slight alkalinity to this latter indicator.

INFLUENCE OF COARSE SUSPENDED MATTER ON FILTRATION.

There is no regular relationship between the amount of coarse suspended matter (which is almost entirely *bagacillo*) and the rate of filtration have (with but one exception) less than 0·02 per cent. of coarse suspended matter, while the higher figures for the coarse suspended matter all belong to the sugars having the lower filtration rates. This does not indicate that sugars low in *bagacillo* are necessarily of good filtering quality, for actually the sugar with the lowest amount of coarse suspended matter is nearly at the bottom of the list, and many of the sugars having a low rate of filtration have actually less *bagacillo* than the best filtering samples. It merely suggests better screening arrangements at the factories in question.

POLARIZATION AND RATE OF FILTRATION.

Again, in the case of these two factors no relationship exists. It is possible for a sugar of high polarization to have decidedly poor filtering qualities, while sugars of much lower polarizations might yet be excellent from the standpoint of filtration.

EXTRACTION AND THE RATE OF FILTRATION.

Difficulty in the filtration of solutions of raw sugars is attributed by some authorities to high mill extraction resulting in the extreme disintegration of the cane fibre. No such conclusion can be drawn from the data here collected. Indeed, it was seen that the raw sugar giving the highest rate of filtration of the entire series was produced at a factory where the extraction is consistently close to 99·0 per cent. It is interesting to note that the *bagacillo* in sugars produced in mills using the Searby shredder is not abnormal, with the exception of Olaa, where the condition is due to lack of a clarified juice screen. Of the five mills securing the best rate of filtration, three use the Searby shredder showing conclusively that intensive disintegration of the cane does not tend to reduce the rate of filtration of the resulting sugars[1]

The Java Sugar Production in 1922.

(American Commerce Report.)

Production.—The cane sugar area cut over in 1922 amounted to 227,016 bouws (a bouw equals approximately 1¾ acres), and the plantings of the new, or 1923 crop were 229,941 bouws. The cane for the 1922 crop had been planted early, which turned out to be fortunate, as the plants had a good start before the dry weather that lasted through January and even through March in some of the Provinces. The dry spell was followed by excessive rains in April, May, and June, but little damage was done, although some difficulty with transport occurred on some of the plantations. The production for the whole of Java was very good, the average being 129·09 piculs per bouw, or something over 5 tons per acre. No special difficulties were experienced with the harvesting, milling, and the replanting, as there was a good supply of labour everywhere and no trouble with the transportation. The new 1923 crop suffered somewhat from the very dry west monsoon, which occurred very late. Certain diseases also appeared, among which were seedling rot, pineapple disease, and blight.

Extensive experiments were made with tractors for ploughing the soil in 1922, and it was ascertained that Reynoso trenches can be dug by mechanical means, but the supply of labour is so plentiful and cheap at present that the use of tractors will be limited so long as conditions remain as they are.

The mills of the trust produced 26,200,000 piculs (1 picul = 136·15 lbs.) of sugar and the independent mills 3,100,000, so that the production of the entire country was 29,272,103 piculs, or 1,808,037 tons, as compared with 27,285,575 piculs, or 1,685,193 tons, in 1921, or the largest crop since 1917. The number of mills operating was 182.

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[1] In the concluding part of this paper, which will be given next month, the improvement of the filtering quality of raw sugars will be discussed.

Sugar Prices.—The year 1922 opened most unfavourably, and during the entire year prices remained at a modest level. At the end of March the Javanese sugar trust had about 12,000,000 piculs of unsold sugar which it held at a price of 12 florins per picul for superior head sugar, but the average price obtained was still lower, as a very great part of this stock was sold at 11 florins to 11·50. The trust limits for lower-grade sugars at that time were 9·75 and 10 florins per picul.

Superior head sugar, 1922 June and July delivery, was sold by speculators at the same time in the open market for 11·50 florins, which was 0·50 florin below the trust quotations, but even these prices were higher than those ruling in other markets, and consequently not only were orders received to sell lots which had been bought for export and were awaiting shipment, but Javanese sugar was even returned from Calcutta to be resold here. One of the greatest difficulties of this market is that, owing to the operation of speculators, prices of the produce of the country are often quoted at higher prices on the market here than the same produce will bring abroad. There are general complaints that certain oriental merchants will speculate heavily and if the market goes against them they simply refuse to deliver.

The limited demand during April was mainly confined to early deliveries of the new stock, the 1921 supply having been exhausted. June-July deliveries brought around 12 florins at the beginning of the month and later in the month the price fell to 11·375 florins per picul, but owing to the fact that the trust had only late sugars to sell, there was little business done. The price abroad rose slightly early in May, but owing to the sale of large stocks of muscavados which had been bought for the Japanese market and resold here, the local market was not influenced thereby.

Owing to weather conditions in this country and to some large orders received from British India, as well as to various reports of a shortage in the visible stock and of a failure of the crop in Formosa, prices rose in August to 14 florins per picul for the 1922 crop, and the trust disposed of the major portion of its remaining holdings at that price. Prices again began to move downward because of the fear that the increased duties in the United States would reduce the comsumption of sugar. In the second half of November, however, new orders from British India were received and the European market showed improvement, so that prices again rose, and the trust, as the United Java Sugar Growers' Association is called, disposed of the remainder of its holdings of the 1922 crop.

The trust had disposed of more than half of its 1923 crop by the end of December, its sales having amounted to 13,865,400 piculs, or 944,087 tons. The prices received, it is stated, were such as to yield a very satisfactory profit.

Cost of Production.—The cost of production varies greatly from year to year, depending upon such elements as the labour supply, excess of rains, drought, and pests, but it seems to be generally accepted that with an average crop and with a more or less normal labour supply, the cost of production is now around 8 florins per picul. From 1907 to 1920 the average costs were as follows:

Year	Cost per picul. *Florins.*	Year.	Cost per picul. *Florins.*	Year.	Cost per picul. *Florins.*
1907..........	5·94	1912..........	6·44	1917..........	6·38
1908..........	5·75	1913..........	6·44	1918..........	7·50
1909..........	5·85	1914..........	5·85	1919..........	8·39
1910..........	6·20	1915..........	6·38	1920..........	9·78
1911..........	6·27	1916..........	7·17		

The Java Sugar Production in 1922.

The figures for 1921 cannot be given, as the rate of taxation for that year had not been calculated at the end of 1922. (The rate was finally set by executive order of the Governor-General on March 1st, 1923.) The sugar tax rate increases from 2 cents per picul when the profit is 1·50 florins per picul, to 4·50 florins per picul when the profit reaches 22·50 florins per picul. Thereafter, for each additional 0·25 florin of profit the tax is increased 0·05 florin. These taxes will be paid during the calendar year 1923.

Correspondence.

AMERICAN BEET VERSUS CUBAN CANE.

To the Editor, "The International Sugar Journal."

Sir,—The United States Tariff Commission has just completed an exhaustive investigation of the cost of producing sugar in continental United States, in our insular possessions, and in Cuba. The preliminary report of the Commission, recently issued, leaves no doubt about the duty on sugar being an agricultural and not an industrial tariff.

This report shows that in 1922 Cuban farmers received an average of $1·16 for each 100 lbs. of extractable sugar in their cane, whereas American farmers received an average of $3·37 for each 100 lbs. of extractable sugar from their beets. In other words American farmers received as much for 100 lbs. as Cuban farmers received for 290 lbs. of sugar. In addition to receiving as much for 100 lbs. of sugar as did Cuban farmers ($1·16), American sugar beet farmers received the full amount of the import duty ($1·76) plus 45 cents.

If American sugar beet farmers received no more for their sugar than Cuban farmers received for theirs, their beets would have brought them only $3·16 per ton, an amount far below their cost of production.

In Cuba the farmers' and labourers' cost of living is a mere bagatelle. The habitations are flimsy shacks costing only a few dollars to erect and furnish ; there is no expense for fuel, clothing is meagre and of the cheapest kind, and the food is plain and inexpensive. In addition to that, Cuba has a supply of cheap black labour right at hand in nearby islands. All the sugar planters have to do is to secure a special decree from the President and labour flocks in in droves.

As long as Cuban sugar producers are able to keep Cuba a one-crop country, thus compelling the farmers to accept the producers' price for cane or starve, Cuba will continue to be the lowest cost sugar-producing country in the world and to expect to maintain the American wage and American standard of living and compete with Cuba will continue to be an utter impossibility.

American farmers grow beets for profit, not from patriotic motives and unless they can make a profit on beets they will devote their fields to the production of other crops, such as wheat, oats, barley, beans, etc., whereas the Cuban farmer, producing nothing but cane would go hungry if he did not accept the price offered by the mill owner.

A slight lowering of the duty on sugar would close American beet sugar factories and thus deprive 100,000 American farmers of a market for $63,000,000 worth of beets annually, while a slight increase in the duty soon would mean the erection of enough new factories to supply us with all the sugar we consume, and of the $380,000,000 we thus would keep at home, over $200,000,000 would be paid to farmers annually for beets.

Washington, TRUMAN G. PALMER.

March 31st, 1924.

Following the favourable results obtained at Aguirre and Mercedita, P.R., the Petree process has also been adopted by the Central Plasuela, P.R., which has a grinding capacity of 1600 tons.

The Beet Sugar Industry in Czecho-Slovakia.

Department of Overseas Trade Report.

The following tables give the results of the beet sugar crops for the years 1913-14 and 1923-24 in Czecho-Slovakia:—

1913-14 Season.

	Land under Beet Cultivation. Hectares.	Beet Harvest. Quintals.	Sugar Production. Quintals.
Bohemia	139,586	41,764,600	7,016,343
Moravia and Silesia	91,861	25,762,600	3,867,292
Slovakia	63,634	12,211,921	1,803,221
	295,081	79,739,121	12,686,856
Equal to Metric Tons		7,973,912	1,268,685

1923-24 Season (according to latest estimates):—

	Land under Beet Cultivation. Hectares.	Beet Harvest. Quintals.	Sugar Production. Quintals.
Bohemia	115,940	30,412,597	5,181,525
Moravia and Silesia	74,236	20,082,896	3,417,056
Slovakia	35,536	7,913,979	1,238,209
	225,712	58,409,472	9,836,790
Equal to Metric Tons		5,840,947	983,679

It can be justly stated that this year's results are extremely satisfactory. Free trade in sugar is now accomplishing what all the decrees and regulations about equal prices, etc , could not effect, and the farmers have been now convinced that under present conditions beet growing pays better than grain. The total beet harvest of the year 1923-24 as given above is about 1½ millions larger than last year's (1922-23). From the current crop there will be large quantities left for export, which already to-day amount to about 650,000 metric tons. From this amount over 200,000 tons of sugar were exported during October and November, and if the export trade develops in the way it has started, we may safely state that until the end of the current year one-half of the total sugar exports will have been reached. This increased export of sugar will, of course, add to the Czechoslovak active trade balance.

At the same time the Government has provided for the demands of the local market by making the sugar factories reserve the same quantities as last year, which reserves proved quite sufficient. The sugar factories have also agreed to keep the price of sugar at 440 Kc per 100 kg. ex factory until September 30th, 1924.

Consumption of Sugar in the United States.

According to statistics published by Willett & Gray, the consumption of sugar in the United States for the past ten years has been as follows:—

Year.	Total Consumption. Tons.	Per Capita. Lbs.	Increase or Decrease from previous Year. Per cent.	
1923	4,780,684	95·63	Decrease	6·128
1922	5,092,758	103·18	Increase	23·992
1921	4,107,328	84 47	Increase	0·555
1920	4,084,672	86·56	Increase	0·418
1919	4,067,671	85·43	Increase	16·365
1918	3,495,606	73·36	Decrease	5·104
1917	3,683,599	78·58	Increase	0·683
1916	3,658,607	79·34	Decrease	3·759
1915	3,801,531	83·83	Increase	1·082
1914	3,760,827	84·29	Increase	0·473

Average yearly increase in total consumption for 101 years, 5·289 per cent.

Publications Received.

Annual Reports of the Progress of Applied Chemistry. Vol. VIII; 1923. (Society of Chemical Industry, Central House, London, E.C.2.) Price: 7s. 6d., post free to members of the Society; 12s. 6d. to non-members.

We are pleased to draw attention to the publication of Vol. VIII of the Annual Reports of the Society of Chemical Industry which review the work done in different branches of chemical technology during 1923. It is hardly necessary again to emphasize the importance of these Annual Reports in enabling technologists specializing in any particular branch of industry to follow the trend in other branches of chemical activity. Their value now appears to be more adequately appreciated. In this issue the section on "Sugar" has been prepared by Mr. ROBT F. LYLE, F.I.C., of the Westburn Sugar Refineries, Ltd., Greenock, who gives a particularly clear and well-balanced account of the literature contributed to our industry during the period mentioned, an account which will be read with advantage by all those finding difficulty in collating the many articles and patent specifications published during 1923. This year the section on "Soils and Fertilizers" is dealt with by Mr. H. J. PAGE, B.Sc., A.I.C., Chief Chemist, Rothamsted Experimental Station, whose remarks on the most noteworthy advances on the practical and technical side of this important domain will be read with interest by all connected with plant production. "Fermentation Industries" is contributed by Mr. H. LLOYD HIND, B.Sc., F.I.C., and here there is a good deal of information for the technologist concerned in the production of alcohol. Mr. HIND tells us that the fermentation of cellulose (to which process attention has already been called in these columns[1]) is likely to be an important industry in the future. Conditions can be controlled during the fermentation so as to produce either alcohol or acetic acid at will, and the direct fermentation process can deal with growths, such as straw (and presumably also bagasse and similar material) without any preliminary treatment other than softening by steam alone or with a small amount of dilute acid, which enables the material easily to be broken down into a pulp. Under "Plant and Machinery," Mr. J. H. WEST, M. I. Chem. E., reviews recently described apparatus relating to evaporation (e.g., the Prache and Bouillon system), filtration, and other technical processes. He is optimistic in regard to the Hele-Shaw "stream line" filter,[2] since after describing this apparatus he remarks that "while the commercial handling of filtering problems in which the solids are the valuable portion has not yet been completely solved in this filter, the solution is now within sight, and only a matter of a little further experimentation."

Summary of Technical Methods for the Utilization of Molasses, collated from Patent Literature. Circular of the Bureau of Standards, No. 145, Department of Commerce; Bureau of Standards. (Government Printing Office, Washington, U.S.A.) 1924. Price: 15 cents.

It is explained in the introduction to this Circular that "economic conditions the world over have made it generally recognized that the future of the American beet sugar industry is to a great extent dependent on the profitable utilization of the molasses produced." Accordingly, a search relating to this subject has been carried on through the files of the patents of the United States, Great Britain, Germany, and France; and the methods which have been proposed for the utilization of molasses by recovering from it technically useful products have been here summarized, the most important of them being at the same time illustrated. These patents have been arranged in seven groups, which are distinguished by the product or products forming the main object of the specification, viz., amines; ammonia; cyanides; nitrogenous non-sugars; potash and alkali salts; and miscellaneous products, while there is also a group concerned with plant. A complete subject and name index is appended to this publication, which is one that should be found useful to those who may have occasion to study methods for the technical utilization of molasses by destructive distillation.

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[1] *I.S.J.*, 1921, 474; 1923, 321.

[2] *I.S.J.*, 1923, 546, 628.

Industrie et Commerce. Edited by Jaroslav Vesely. Encyclopédie Tchécoslovaque. (Editions Bossard, Paris and Prague) 1923.

This is the first volume (in the French language) of a series of books which are being published on Czecho-Slovakia, its political organization, social, intellectual and artistic life, agriculture and finances. It presents an account of the industries of this country, that on Sugar being written by Messrs. MANSFELD and DIVIS, who briefly sketch its development. They give an interesting review of the technical history of the industry, during the reading of which one is reminded of the inventions of ROBERT, JELINEK, DANEK, WEINRICH, GOLLER, STEFFEN, and others. A few words are said about the well-known Experiment Station, founded in 1895, from which many valuable researches on chemical, technical, and agricultural matters have originated. In 1922 the staff of this Station moved to a splendid new building in Prague, which is probably the most up-to-date and well-equipped institution of its kind, on the Continent at any rate. Mention is also made of the several organizations controlling the manufacture and the sale of sugar, and some statistical data are also presented.

Suggestions for establishing the Beet Sugar Industry in England on a Sound Basis. Compiled by George de Belle Ball for the East Suffolk Development Syndicate Ltd. (34, Nicholas Lane, London, E.C. 3).

A Pamphlet drawn up to explain at length the Southwold area project of the East Suffolk Development Syndicate Ltd. This, briefly stated, comprises the development of agriculture on co-operative principles and especially the agriculture of sugar beets. One or more sugar factories are projected, and an extensive system of light railways to link them up and facilitate the cheap carriage of beets and other farm produce to the centres of distribution is an essential part of the scheme. A good deal of the pamphlet is devoted to arguments and statistics in favour of developing this industry in England.

Trade Notices.

Maxwell Jagged Rollers.

The Sugar Machinery Manufacturing Co., Ltd., of 76, Elsham Road, London, W. 14, have recently issued a well illustrated brochure, describing in detail the special features of the Maxwell Patent Jagged Roller, which was first placed on the market in 1915, but has since then been further improved. (An illustration of the design can be seen on our inside back cover.)

The object of these rollers is briefly to secure the benefits of thorough disintegration when crushing hard canes without running into the expense, upkeep, and steam consumption attendant upon separate shredders or other preparers. Various combinations of these rollers in a milling train are suggested; and one type of roller is a Renewable Surfaced Roller in which the shell is built up in segmental strips, covered by keep rings at each end, and with dovetails set in hard fusible alloy. By means of this last construction it is claimed that rollers are easily re-surfaced in the factory workshop in the off-season, when worn by long use.

Barclay Locomotives.

Messrs. Andrew Barclay, Sons & Co., Ltd. of Kilmarnock, Scotland, have just issued a new Catalogue "CK" which is to take the place of Catalogue "CG." The subject matter has been revised, re-arranged and brought up-to-date and an Index provided. The contents show particulars and illustrations of a large variety of types and sizes of Barclay Locomotives, built for either Coal, Wood or Oil Fuel as required.

Review of Current Technical Literature.[1]

Milling Extraction in Java, compared with Australia and Hawaii. *Ph. van Harreveld. Archief, 1923, 31, No. 51, 1417-1419.*

In stating his "werkplan" of the Experiment Station for the year 1924, Dr. van Harreveld remarks that in Australia and Hawaii "enormously greater" quantities of maceration water are used than in Java, and a much higher extraction obtained. It would appear from the control figures that in Java a high maceration does not help greatly, and that in fact some factories already use too much water considering the effect they realize. Some technologists believe that the superior extraction in Hawaii depends on the preparatory treatment given there, which if true would mean that the introduction of modern crusher and shredder installations into Java would meet with special success, whereas this does not appear to have been the case. Besides, in Hawaii some mills which are not equipped with the modern preparatory devices obtain as high an extraction as is obtained in Java with these installations. The visit of the Inspector of Factories of the Colonial Sugar Refining Co., Ltd., of Sydney, afforded an opportunity of discussing the question, and the opinion was elicited that maceration in Java was carried out in a primitive way. In Australia, on the other hand, matters are so arranged that the maceration water remains in contact with the bagasse between the mills for about 10 mins., this being done in a closed trough fitted with a rake conveyor and a device for re-circulating the water. A special feeding device is provided for putting the very wet bagasse into the next mill, souring being prevented by bringing the maceration water to 100°C.: while inversion is checked by adding lime to it, part of the clarification therefore taking place at this place, and the quantity of mud ordinarily later obtained diminished. Summarizing his remarks, Dr. van Harreveld expresses the opinion that the inferior position of Java in respect of milling extraction is not due to the milling installations there, but rather to the maceration. This year he intends to commence trials for the purpose of establishing this belief.

Simplified Method for the Determination of Sugar in Bagasse. *W. C. Nieboer. Archief, 1924, 32, No. 2, 31-34. G. A. ten Bokkel Huinink. Ibid., 1924, 32, No. 2, 34-63.*

Mr. Nieboer points out that one of the most important analyses of the factory laboratory, that of the determination of sugar in bagasse, is quite generally carried out in such a way as to lead to error. Thus, the bagasse is boiled in an open vessel, and the water evaporated during this operation is made up by gradually dropping in what is judged to be the same volume; but this manipulation is difficult to adjust, and leads to considerable discrepancies in the final weight of the liquid. A better method[2] provides an apparatus having a reflux condenser for obviating any loss of water by evaporation during boiling; though in applying it care has to be taken that the bagasse does not collect on the surface of the boiling liquid, which can be prevented by shaking the vessel from time to time. But this improved procedure does not appear to have been adopted to any extent in the laboratories of Java factories, the older one being preferred for routine work carried out by native assistants. Mr. Nieboer requested Dr. ten Bokkel Huinink to carry out a series of investigations comparing various modifications of these methods of determining sugar in bagasse. Numerous experiments are here described by the doctor, some of these showing clearly that Method 1 gives very widely varying results, the conclusion being drawn that it must be regarded as quite unreliable. Method 2 the "hot" procedure, using a reflux condenser, on the other hand, was found to give reasonably regular results. Then at the suggestion of Mr. Nieboer quite a new procedure was elaborated, in which extraction is carried out *in the cold*, using a different type of apparatus altogether. It consisted of four copper cylinders, the open end of each of which was closed by means of a rubber stopper, held down by a screw clamp, these cylinders being clamped to the spokes of a vertical wheel, capable of rotation by hand or by power.[1] In each of the cylinders is placed 20 grms. of bagasse and 250 c.c. of water, the shaking together of which is effected by the rotation of the wheel. Dr. TEN BOKKEL HUININK found that this "cold" method in comparison with Method 2 gave distinctly lower results, and the reason for this seemed to be traced to the degree of division of the bagasse, the important observation being made that the cold and hot methods give the same figures provided the bagasse be ground to a sufficient degree of fineness, e.g., so that it all passes through a sieve having round perforations at least 2 mm. in diameter. Still, the difference between the cold and the hot methods might be due to a cause other than the more ready extraction of the sucrose in the latter, namely, the solution during the heating process of a "non-sugar" having a dextro-rotatory effect on the polarization. This possibility was investigated by determining the sucrose by means of Fehling's solution as well as polarimetrically when carrying out both the cold and the hot methods; but no indication of the solution of optically-active substances (unprecipitable by basic lead acetate) could be obtained. Yet another possible source of error (this time in the opposite direction) might be the decomposition of the sucrose present in the dilute solution during boiling; but carefully controlled tests showed the sucrose content of such dilute bagasse extracts to remain constant throughout the period of boiling. Lastly, it is remarked that for the sub-division of the bagasse to particles passing 2 mm. in diam. a special machine is necessary, that ordinarily used in Java being incapable of cutting to this degree of fineness. If the bagasse be not divided so finely as this, it is impossible to extract all the sugar with cold water even after a prolonged period of shaking in the rotary machine. Experiments are described demonstrating that the amount of sugar retained by the bagasse is dependent upon the size of the particles. It is therefore possible to work with the cold extraction method using bagasse which has been divided so as to pass through a sieve having holes 4 mm. in diam.; but if this be done the result must be multiplied by the factor 1·19 in order to obtain the results obtainable by the cold method with 2 mm. division.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Bulletin No. 3, "Handleiding ten dienste der Molencontrole," page 37.

CLARIFICATION OF CANE JUICE BY SUPERHEATING BEFORE LIMING. *Maurice Bird.*

La. Planter, 1924, 72, No. 13, 257.

Details of this process and of the results obtained by it have already been reported[2] and now some further particulars are given. In the laboratory previous to trying the process in the factory, raw cane juice was heated in an autoclave to 241°F. (116°C.) in the manner and for the reason suggested by MULLER,[3] a precipitate being thus thrown down, amounting to 44 per cent. by weight of the juice. It comprised 58·74 per cent. of ash, which contained 34·03 per cent. of silica, 47 per cent. of phosphoric acid, and 1·06 per cent. of magnesia. It could be strained off quite easily. On applying the process on the factory scale, however, it was found that instead of previously separating it a better clarification was obtained by liming the superheated juice on its exit from the heaters, thus obtaining a double precipitate, which was subsided, and filter-pressed. No inversion could be detected as the result of passing the raw juice through the high-velocity juice heaters at the temperature named. During the first half of last year, when the only difference in manufacture between this season and previously was this modification of "superheating," the recovery of commercial sugar from the juice was 92·86 per cent., whereas previously the best figure for a similar period had been 89 per cent., the analysis of the juice being as follows: Brix, 13·83°; sugar, 11·21; reducing sugars, 1·08; ash, 0·491 per cent.; and purity, 81·00. Further, a sugar was obtained of remarkable purity and attractive appearance, considering that only lime had been used and that the low grades were incorporated with it, analysis giving the following figures: Water, 0·976; polarization, 96·03; matter insoluble in water, 0·033; and "crude gums," 0·186 per cent. Laboratory work has indicated that besides removing a large part of the colloidal silica from the juice, other colloids (here called "crude gums" for want of a more exact name) are removed by the superheating process and by settling. This conclusion is borne out by the very small percentage of "crude gums" (that is, gummy matter precipitated by alcohol from the raw juice) left in the sugar. It would seem that the quantity of these "crude gums" removed by the superheating is proportional to the acidity of the raw juice, as well as on the degree of heat, but a great deal of future work is required to settle this and other questions bearing on the matter.

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[1] This apparatus is therefore somewhat similar to that devised by Dr. G. L. SPENCER. See *I.S.J.*, 1921, 630.

[2] *I.S.J.*, 1923, 358, 464.

[3] *I.S.J.*, 1921, 579.

EXTRACTION OF SUGAR FROM DESICCATED CANE. *E. Saillard.* *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France, No. 1829.*

A scheme is on foot in Madagascar for the cultivation of cane, its shedding and desiccation, and the exportation of the *poudre de cannes* thus obtained to French beetroot factories for the extraction during the inter-campaign of the sugar present in it. MM. CARLE, GOHIER and HERSCHER, of Saint Louis, have prepared some of this desiccated cane, and have found it to give the following figures on analysis: Water, 3·45; sucrose, 60·30; reducing sugars, 2·71; salts, 0·62; insoluble mineral matter, 0·62; organic non-sugars, 3·02; cellulose, gums, etc., 29·38 per cent. M. SAILLARD, on examining some of the product on its arrival in France found the figures to be: Water, 2·68; sucrose (Clerget), 61 93; reducing sugars, 3·00; and ash (carbonated), 1·68 per cent. He draws attention to the experiments along the same direction which were carried out at Nipa Bay, Cuba, and the Madison factory, near Michigan, U.S.A.[1] In regard to the extraction fo the sugar from the shredded mass, this is not so easy as might be anticipated, the diffusion process presenting considerable difficulties owing to the physical nature of the material, though favourable results are expected by washing in centrifugals, which gives a juice at 14° Brix, and a bagasse containing not more than 0·01 per cent. of sugar, with great rapidity of working. This bagasse could be used for the manufacture of paper, while it would also be possible to extract the wax present in it.

CHEMISTRY AND CONFECTIONERY. *Stroud Jordan.* *Industrial and Engineering Chemistry, 1924, 16, No. 4, 336-339.*

This is a general outline of the theme that "the manufacture of confectionery is fast becoming a specialized industry, depending upon the careful selection and use of all raw materials, solution, evaporation, crystallization, dehydration, disintegration, blending, colouring, and flavouring, each playing a part." A classification of the raw materials used is made, and a brief description of the manufacture of the following products is given: fruits, sugar creams, hard candy, coconut goods, marshmallow goods, pastilles, gum goods, coated goods, almond paste, and chocolate products. A discussion is given of problems with which the chemist of this industry is confronted, such as the control of raw materials so as to conform with local and Federal food laws; temperature control, which is necessary in every process in which evaporation takes place so as to ensure uniformity of production; moisture control, since a difference of 1 per cent. of water in a finished product often spells success or failure in its carrying or keeping properties; inversion, which will take place in products of an acid nature at ordinary room temperature, and "shelf life," which is controlled by various factors, mainly by the water content, and should be determined for each individual confection. Other matters claiming investigation are: "structure study," by which is meant the study of the best "texture" for each class of goods; colour investigations, which are carried out by observation through glasses, and reference of each batch of colour to the same standard. Under the heading of decolorizing problems, the author remarks that there are many carbons that remove the colour from raw sugars very effectively, which does not mean that it will be profitable for the confectioner to use raw sugar and refine it by this process unless the amount per day will warrant such an outlay, and that further decolorised syrups made from raw sugars cannot be used entirely to supplant syrups made from refined, since the process of decolorizing does not remove all the ash and organic non-sugars, which on a high boil have a decided effect on the syrups.

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[1] *I.S.J.*, 1918, 567.

Refining Cuban Raw Sugar with "Norit" in a Belgium Beet Factory. *A. Wassing*. *Archief, 1924, 32, No. 6, 136-142.*

During 1920 the Vieux-Lille sugar factory, Belgium, worked up Cuban raw sugar to a white product, using "Norit" decolorizing carbon as the refining agent, and a few particulars are here given of the procedure adopted: After pugging the raw sugar (polarizing 96·5—97·0°C.) with syrup, it was washed with water in centrifugals to crystals polarizing 98·0—98·5°, which were melted in a de Vries-Robbé apparatus (a cylindrical tank provided with a false bottom and stirring gear) giving a liquor having a density of 30° Bé. at 95—98°C. (about 62° Brix at 17·5°C.), which was sent to the carbon mixing vats, where with steam injection it was incorporated with the "Norit." A quantity of phosphoric acid was added at this stage, sufficient to impart an acidity equal to 0·0042 to 0·0053 per cent. as H_3PO_4. Filtration was effected through Kroog presses, and later through Dancks, a brilliant light-coloured liquor at 57·5° Brix at 17·5° C., which was sent to the pans, being thus obtained. When the "Norit" had been exhausted as the result of this treatment, the cakes of carbon were sweetened off, steamed, and submitted to regeneration, using hydrochloric acid, soda treatment, or reburning. In the former case, dilute hydrochloric acid was added until the acidity of the mixture of carbon and water was about 0·7 per cent. HCl, after which the mixture was boiled for 20 min. This was found to reduce the ash from an average of about 6·8 per cent. to one of 3·1 per cent. Soda regeneration was used "to remove as much as possible the colouring substances which have been adsorbed by the microscopically fine "Norit" capillaries, thus gradually diminishing the decolorizing power." At another factory (Groningen, Holland) soda regeneration has been abolished entirely, HCl regeneration only being applied with an occasional reburning; but it is stated here that for cane sugar as worked up in the Belgian factory a soda regeneration was found positively necessary. Reburning was carried out in the "Norit" furnace at a temperature of about 600° C., and at the conclusion of this operation a slight washing with HCl was generally necessary to lower the ash, which had risen on the average from 3·4 to about 4·0 per cent. Data regarding quantities and costs of the refining process here outlined are not stated in this article.

Clarification of Beet Molasses for Analysis, using Herles' Basic Lead Nitrate Method. *G. Dorfmüller*. *Vereins-Zeitschrift, 1924, 135-140.*

According to Herles' method,[1] which produces very light coloured liquids, a solution of lead nitrate (containing 500 grms. per litre) is added to the normal weight solution or double normal weight solution of molasses, raw sugar, or other product, this addition being immediately followed by an equal volume of a solution of caustic soda (containing 50 grms. per litre). Herles stated[2] his method of clarification to give polarizations agreeing favourably with those found in the ordinary way, *i.e.*, by means of a solution of basic lead acetate. K. C. NEUMANN,[3] however, obtained results showing it to give higher polarizations; while A. HERZFELD[4] described experiments leading to the contrary conclusion. In order to endeavour to establish a decision on the matter, the author has carried out a good number of tests under varying conditions, and has arrived at the following conclusions: Herles' clarification gave results agreeing well with those found by means of basic lead acetate provided the two reagents (the lead nitrate and the caustic soda) were added in portions at a time one directly after the other, and the whole liquid mixed well together, care being taken to avoid the formation of froth. When, on the other hand, the necessary volumes of the two reagents were added all at once, the polarizations given by Herles' method were sometimes higher and sometimes lower than those given by the basic lead acetate clarification, the differences being of the order of ± 0·25°. Other methods of adding the reagents were tried, but the most satisfactory results were obtained by that cited above in which the reagents were added in portions at a time.

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[1] Herles' clarification for polarization has been included as an official procedure in the methods of analysis practised by the Czecho-Slovakian factories.

[2] *Zeitsch. Zuckerind. Böhm.*, 13, 557-570. [3] *Ibid.*, 21, 183-188.

[4] *Zeitsch. Ver. Rübenzuckerind.*, 40, 207.

Review of Current Technical Literature.

"PURIT" FURNACE FOR THE REVIVIFICATION OF DECOLORIZING CARBON. *Anon.*

The Chemical Age (March 22nd, 1924), *10, No. 249, 289.*

The "Purit" Company, of Groningen, Holland, have introduced a furnace for the revivification of carbon of very simple construction, consisting of a horizontal cast-iron cylinder which has a total length of about 4½ ft. Inside the cylinder there is a horizontal shaft and stirrer, which is driven by mortice-wheels and worm-wheel so as periodically to change the direction of rotation, so that the shaft consequently alternately rotates to the right and to the left. The whole is walled in with fireproof material, round which flue gases are conducted.

In operating the furnace, the carbon is thoroughly washed in the filter-presses, dried as completely as possible by means of steam or hot air, and introduced into the cylinder. The furnace is then fired up, and the stirrer is then set in motion to prevent the carbon clogging together during the process, the carbon being heated in the furnace in absence of air to a temperature of about 900° C. This process is considered complete when a sample of carbon from the furnace boiled with an alkali solution imparts no coloration to the filtrate. The carbon is removed from the cylinder by opening the exhaust flap; the stirrer itself meanwhile working the material out of the cylinder into a water-tank. From this tank (in which it is kept in suspension by a stirrer) the carbon is pumped with the water it contains to a filter-press. With continuous working of the kiln about 100 kg. of coal are required for the reactivation of 100 kg. of carbon, and with a normal type of furnace it is possible to deal with 500 kg. of carbon in 24 hours. The operation of the furnace necessitates the attention of one man only; and a 1 h.p. motor is required for operating the mechanism. In addition, 6 to 8 litres of hydrochloric acid of 20° Bé. per 100 kg. of reactivated carbon are required. Carbon reactivated in this way, it is claimed, has not only recovered its full decolorizing power, but also its full filtering power, and the formation of carbon from the adsorbed organic matter is said to be of no prejudicial influence.

DETERMINATION OF REDUCING SUGARS COLORIMETRICALLY USING PICRIC ACID. *Mayne R. Coe and G. L. Bidwell.*

Journal of the Association of Official Agricultural Chemists, 1924, 7, No. 3, 297-304.

When solutions of reducing sugars are heated with a solution of picric acid and an alkali, a yellowish red or yellowish brown colour is developed, the depth of which is proportional to the amount of sugar present, so that comparison with a standard solution may be made colorimetrically. A number of chemists have used a method similar in principle to this with more or less satisfactory results,[1] and the authors now claim that they have elaborated a reliable procedure for use in the analysis of foods and feeding stuffs, the special advantages claimed being that it is quicker than the copper reduction method, that the preparation of crucibles is avoided, that no bulky solutions are required, and that manipulation is simplified.[2] It is carried out in the following way: 3 grms. of the sample and 100 c.c. of 50 per cent. alcohol are introduced into a 250 c.c. flask, boiled on the steam bath for 1 hour, cooled, made up to the mark with 95 per cent. alcohol, shaken well, and filtered; 150 c.c. of the filtrate are pipetted into a 400 c.c. beaker, and evaporated on the steam bath to about 10 c.c. (until only a trace of alcohol is left), this liquid being taken up with water, transferred to a 100 c.c. flask, and made up to the mark. This solution after filtering is saturated with dry picric acid; allowed to stand for 15 min., and again filtered. Three c.c. portions are pipetted into two Nessler tubes graduated to 5, 10, 15, 20, and 25 c.c., one of these tubes serving for the total sugars and the other for the reducing sugars, to which latter 1 c.c. of 22 per cent. sodium carbonate solution is added. Both are placed on the steam bath for 20 min., together with a tube containing 3 c.c. of an 0·02 per cent. standard solution of dextrose saturated with dry picric acid plus 1 c.c. of the alkali. After 10 min., 1 c.c. of the alkali is added to the tube for the total sugars while it is still in the bath. After cooling, and diluting to a proper shade, the solutions are compared in a Dock-Benedict colorimeter or other suitable apparatus. J. P. O.

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[1] LEWIS and BENEDICT, *J. Biol. Chem.*, 1915, 20, 61.

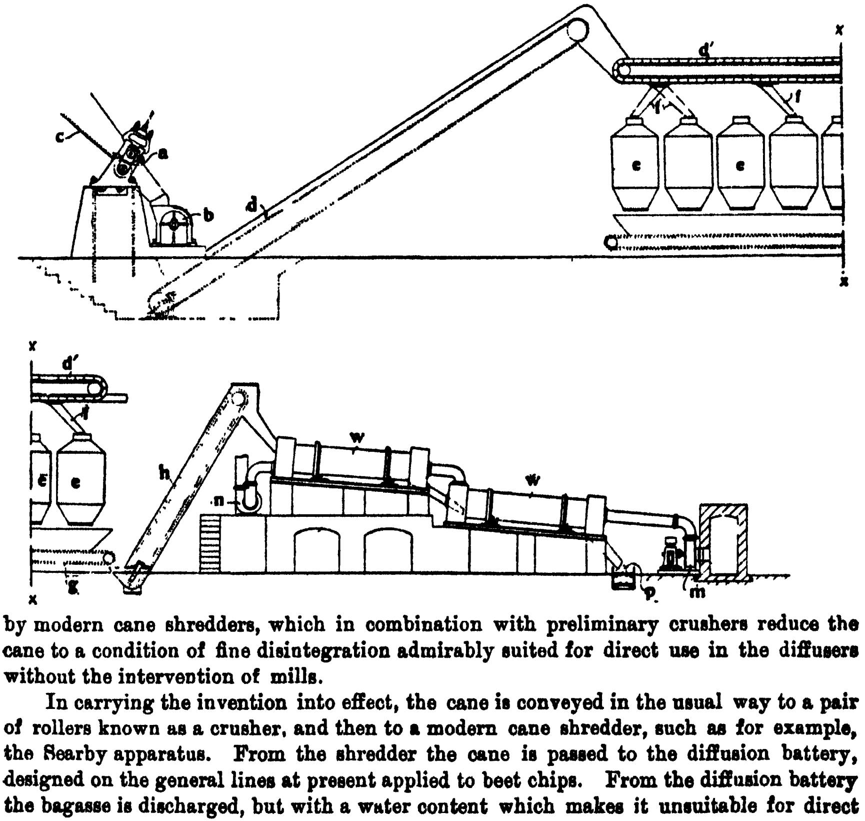
[2] DEHN and HARTMAN, *J. Amer. Chem. Soc.*, 1914, 36, 403. ROSE, *J. Biol. Chem.*, 1921, 46, 529. BERNARD, *Sugar*, 1915, 17, 41.

Review of Recent Patents.[1]

UNITED KINGDOM.

EXTRACTION OF CANE JUICE BY CRUSHING, SHREDDING, AND DIFFUSION. *Robert Mitchell and Emil G. Wuthrich,* both of 115, Holland Road. Kensington, London, W. 14. *210,692.* May 31st, 1923.

This invention is concerned with a method of extracting juice from cane which will allow of the entire abolition of mills in any factory, which will allow the highest possible juice extraction, which will afford purer juice than can be obtained by a heavy train of say five mills, and which will allow of obtaining a bagasse fuel of the highest calorific value. It consists in reducing the cane into a condition of fine disintegration by shredding after a preliminary treatment by a crusher but not such a treatment as is given by mills, and then subjecting the disintegrated cane to a diffusion treatment. It has heretofore been proposed to shred the cane and then subject the shredded cane to a diffusion process, but not after a preliminary crushing. To render the bagasse thus produced suitable for use as fuel in furnaces the moisture is removed by means of hot air or hot flue gases and not by milling. These improvements are based upon and made possible by recent results obtained by modern cane shredders, which in combination with preliminary crushers reduce the cane to a condition of fine disintegration admirably suited for direct use in the diffusers without the intervention of mills.



In carrying the invention into effect, the cane is conveyed in the usual way to a pair of rollers known as a crusher, and then to a modern cane shredder, such as for example, the Searby apparatus. From the shredder the cane is passed to the diffusion battery, designed on the general lines at present applied to beet chips. From the diffusion battery the bagasse is discharged, but with a water content which makes it unsuitable for direct use as fuel. The bagasse is then passed through a dryer, preferably of the drum type—though other types may be employed—or through a series of these dryers, the heat for drying being obtained from the flue gases from the boiler range. By a system of fan injection of the hot flue gases, combined with a suction fan discharge of the vapour from the moist bagasse, the final bagasse fuel is delivered to the boilers in a state of low moisture content and in a condition admirably adapted for fuel. Apparatus suitable for carrying into effect the improved method is illustrated diagrammatically in the accompanying drawings, in which *a* denotes the preliminary crusher including a pair of toothed rollers and *b* a shredder of modern type located beneath it. Cane is conveyed to the crusher *a* by a carrier *c* in the usual way and passes through the toothed rollers which extract about 55 per cent. to 60 per cent. of the weight of the cane in juice, the juice falling down into the usual receptacle and being conveyed by a pump to the clarification plant. From the crusher the cane, now in partly-crushed condition, falls by gravity into the shredder *b*, which is a relatively high speed machine running at say 300 revolutions per minute. This tears and disintegrates the cane, leaving it approximately like the fibre of a coco-nut mat, admirably suited for further treatment in the diffusers and not in a condition similar to that which would result from slicing or from crushing alone. An ordinary conveyor *d* takes the shredded cane and deposits it on a horizontal conveyor d^1, disposed above a series of diffusion vessels, a double row of diffusers *e*, six in a row, being employed, in the form illustrated. The number and size of these diffusers will vary considerably, according to the size of the plant. Movable chutes *f* are employed to take the bagasse from the conveyor into the mouths of the diffusers, in which diffusers the bagasse is packed in exactly the same way as the beet chips are packed in a beet sugar plant. The process of diffusion, well known in the industry, is carried out with the bagasse in precisely similar manner to the prevailing practice in beet sugar plants, the time taken being, however, less. The mass is discharged to a conveyor *g* from the diffusers in known manner, and when thus discharged it will have the following composition :—Fibre, sugar, etc., about 35 per cent.; and water about 65 per cent. From the diffusers *e* and conveyors *g* the bagasse is taken by an ordinary elevator *h* to a series of dryers *w* and *w*, shown as being in the form of a pair of rotary drums suitably driven. The drums are inclined, and the bagasse passes by gravity from one rotating drum to the next. In these drums it is subjected to a series of falls in the interior and in falling is traversed by a current of hot air obtained from the boiler flue as shown. In the form illustrated, the hot gases from the flue are by means of a fan *m* forced in at one end of the lower drum *w*, while the hot gases, laden with vapour, are discharged by a suction fan *n* located adjacent to the first drum *w*. The partly dried bagasse is withdrawn at *p* ready for use as fuel.

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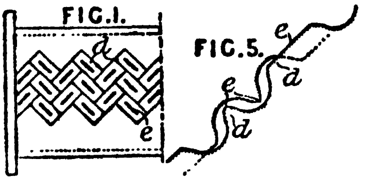
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

The temperature of the flue gases would be approximately 500° F., and the speed of rotation of the drums and other conditions regulated in such manner that the water content of the discharged bagasse will be somewhere about 15 per cent. to 20 per cent., in which condition it is excellent for burning. The discharged bagasse is conveyed conveniently by an ordinary conveyor to the boiler range, where by means of hoppers and suitably designed grates, it is used as fuel.

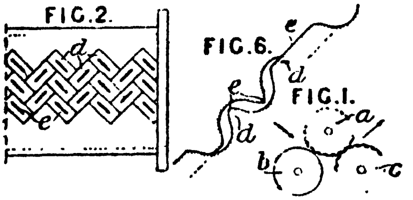
CANE MILL CRUSHERS. *Hugh W. Aitken*, of Britannic House, 4, Park Circus, Glasgow, Scotland. (*A*) *209,483*. October 10th, 1922. (*B*) *209,484*. October 10th, 1922.

(*A*) The object of the invention is to enable the cane to be effectively broken and the juice squeezed therefrom, and to provide means to facilitate the escape of the juice and prevent its re-absorption by the bagasse, while preventing the passing of uncrushed cane or bagasse between the rollers (in passages provided for the escape of juice). It has heretofore been proposed to provide intermeshing ridged rollers of mills with gaps or grooves cut in the ridges at right angles to the axes of the rollers for the purpose of allowing of the escape of juice in a circumferential direction. With such a construction cane or bagasse would pass in these grooves between the rollers and thus escape the nip of the rollers. A more serious objection is that the grooves would get choked with cane or bagasse and soon cease to function as desired. If such grooves are made narrow to avoid much cane passing through uncrushed, they will the more easily become choked. If made broad with a view to avoiding or reducing choking, they will let through more uncrushed cane. It has also heretofore been proposed (with the object in view of allowing of the escape of the juice in a circumferential direction) to provide rollers with zig-zag gutters or channels which extend round the circumference of the roller and divide it into diamond or rhombus shaped figures which are grooved and ridged. In the use of such rollers, there is no entering into the zig-zag gutters by ridges on the co-acting roller. The present invention consists in the employment of rollers having intermeshing ridged surfaces, and passages or channels to allow of the escape of the expressed juice in a circumferential direction, the said ridges and passages being arranged as set forth. The juice escape passages according to the present invention are the hollows between contiguous ridges on the one roller and receive the ridges of the co-acting roller. As shown in Fig. 1, each roller has rectangular projections *d* of pyramidal form, the apex being a line *e* and the slopes being curved for intermeshing as shown in Fig. 5. The channels for the circumferential escape of the juice lie between the sides or sides and ends of the ridges. The ridges may be more elongated than is shown, and they are inclined to the axis of the roller at or near 45°.

(*B*) This invention consists in a crusher with a single upper roller co-acting with each of the two lower rollers, characterized by the fact that the upper and the second lower roller have intermeshing ridged and furrowed surfaces, the angle of the ridges to the axis of the roller being far removed from 90°, and the surfaces of both these rollers, or of the second lower roller only, being arranged with gaps or passages or circumferential channels to allow of the escape of the juice in a circumferential direction, while the first lower roller does not intermesh with the upper roller. The first lower roller may have a comparatively smooth surface, although the surface may be formed with cane-gripping serrations and may also have juice-escape grooves, such as are commonly used on the "smooth" surfaced rollers of mills. Alternatively, the first lower roller may have a surface formed with circumferential ridges, with intervening grooves, of large, or fairly large, dimensions suitable for splitting the cane. Rollers with circumferential ridges of large dimensions furnish—by the grooves intervening between the ridges—channels for the circumferential escape of the juice. Such rollers—that is with ridges at right angles to the axis of the roller—have heretofore been employed, both intermeshing and non-intermeshing; and it has been proposed to construct a three-roller mill with the upper and second lower roller so ridged, and intermeshing, the first lower roller being smooth. Rollers so ridged serve well to split the cane, and they allow of the circumferential escape of the expressed juice; but they do not break the cane and reduce it to the same condition as can be accomplished when the ridges are parallel to the axis of the roller or inclined at a small angle or moderate angle—say 45°—thereto. They are not therefore satisfactory for the second squeeze in a three-roller crusher; and it is in the second squeeze that the question of juice escape is of paramount importance. It has also been proposed to provide intermeshing ridged rollers of sugar cane mills with grooves cut through the ridges to allow of the escape of the juice in a circumferential direction; but no proposal of this nature (as far as the inventor is aware) has heretofore been made with respect to a three-roller crusher with two (and only two) intermeshing rollers as above set forth. The non-intermeshing of the first lower roller according to the present invention with the top roller (which is ridged) allows of more cane being drawn into the mill than could be drawn in were the two rollers to intermesh. With a greater amount of cane drawn into the mill, there is no more juice to be dealt with, and hence the greater necessity for juice escape



PATENT 209,483.



PATENT 209,484.

grooves in the second lower roller (and, if desired, also on the top roller). The first lower roller co-acting with the top roller forms a forced feed to the second lower roller and the top roller which intermesh. Referring to Fig. 1 is shown a mill with an upper roller co-acting with each of two lower rollers, the upper roller *a*, and the lower roller *c* on the delivery side having intermeshing ridged and furrowed surfaces. The angle of the ridges to the axis of the rollers is far removed from 90° and the surfaces of both rollers, or of the roller *c* only, are arranged with gaps or channels to allow of the escape of the juice in a circumferential direction, while the lower roller *b* on the inlet side does not intermesh with the upper roller *a*. The roller *b* has a comparatively smooth surface, but it may have cane-gripping serrations and the usual juice grooves. The rollers *a*, *c* may have rectangular projections *d*, Figs. 2 and 6, of pyramidal form, the apex being a line *e* and the slopes being curved. The gaps shown allow of the escape of the juice. The roller *b* may have circumferential ridges with intervening grooves of large dimensions suitable for splitting the cane.

PRODUCTION OF A NITROGENOUS FERTILIZER. *P. Jorgensen*, of Jutland, Denmark. *206,363*. November 8th, 1922.

A manure is obtained by mixing finely divided tuberous roots of leguminous plants with neutralized and sterilized organic earth, nitrifying bacteria being added after the mixture has been allowed to stand until the nitrogen-assimilating bacteria in the roots develop actively, sunlight being excluded. The organic earth is neutralized with lime or phosphate of lime, and mixed with water closet manure, which causes its temperature to rise, the temperature being afterwards reduced to 30 or 35°C.

ALCOHOL DISTILLATION AND DEHYDRATION. *E. C. R. Marks* (communicated by the *U.S. Industrial Alcohol Co.*, of New York). *206,747*. January 11th, 1923.

Water is separated from alcohol (e.g. 95 per cent. spirit) by distilling it in presence of a liquid which is substantially immiscible with water but miscible with alcohol, such as benzol, carbon tetrachloride, hexane, etc., in a rectifying column, when water-free alcohol is obtained as the residual liquid from the base of the column and vapours are evolved consisting of a mixture of water, alcohol, and the added liquid.

PREPARATION MADE FROM SUGAR AND AMINO-BODIES. *J. Schmidt*, of 47, Neue Friedrichstrasse, Berlin. *206,854*. November 10th, 1923; convention date, November 11th, 1922.

A substance resembling malt extract is prepared by heating to 100-150°C. a mixture of sugar and amino-bodies such as hydrolized albumen, and, in particular, hydrolised or autolized yeast. Sucrose, invert sugar, maltose or dextrose may be used.

FILTER. *H. S. Hele-Shaw*,[1] of Westminster, London, S.W. (*A*) *210,101*. July 19th, 1922. (*B*) *210,276*. July 19th, 1923.

(*A*) A filter comprises a pack of plates or sheets of paper or other material substantially impermeable to the fluid, at any rate, in the direction of flow, compressed between inlet and outlet end plates and so perforated that inlet and outlet tubes are formed within the pack, the liquid filtering between the sheets from the inlet tubes to the outlet tubes. (*B*) Suspended matter is separated from a fluid by causing the fluid to pass between sheets or plates of paper which is substantially impermeable to the fluid at any rate in the direction of flow. A pack of sheets may be arranged between pressure heads or end plates, the sheets being perforated so that a continuous passage is formed into which the fluid is forced so that it has to pass between the sheets and escapes at the outer periphery. The paper may have a rough surface or channels may be formed thereon by printing or embossing. Screws or hydraulic pressure may be used to regulate the distances between the sheets. The filter may be constructed as described in Specification 210,101 (above).

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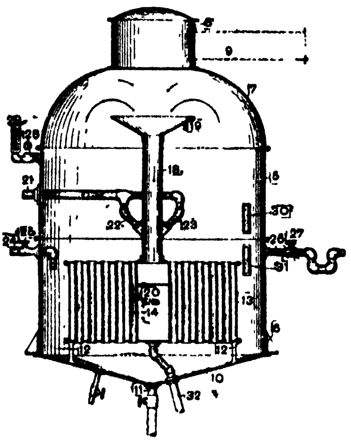
[1] *I.S.J.*, 1923, 546, 628.

UNITED STATES.

Evaporator with Means for eliminating Condensed Water. ***Oscar M. Nelson*** (assignor to ***The United States Sugar Co.***, of New Haven, Conn., U.S.A.). *1,481,924.* January 29th, 1924.

This invention relates to an improvement in evaporators used to evaporate dense liquors (as cane and beet juices) requiring concentration, the object of the invention being to provide an evaporator which avoids the necessity of vacuum pumps and sweet-water pumps, in other words, to produce a device which will accomplish the desired result of condensing liquors in a simplified manner. In carrying out the invention the inventor employs a cylindrical body *5* of suitable size and built up from sheet metal in the usual way, provided with lugs *6* by which it may be suitably supported. The upper part of the body *7* is crowned and mounted upon the crown is a closed dome *8* which may have an outlet *9* for excess vapour, as indicated in broken lines, if such outlet is necessary. The bottom *10* is concave, leading to a mud discharge pipe *11*. Supported upon the bottom by legs *12* is a drum *13* smaller in diameter than the diameter of the casing and extending through this drum and coupled with the top and bottom thereof are a series of tubes *14*. These tubes are arranged in a special way. A number of the pipes are arranged equi-distant from each other in the form of a square at the centre, the pipes on each side of the square forming the arms of a cross being separated from each other equidistantly, or in rows corresponding to the central tubes, but the pipes at the ends of the arms are arranged in transverse rows closer together than the longitudinal rows; then in the corners formed by the arms of the cross are placed pipes in rows in line with the pipes of the arms of the cross. For example, the pipes around the central part of the drum and extending toward each side will be spaced 1¼ in. in one direction and 1 in. in the other direction. This permits of free circulation of steam around the pipes and permits the steam to freely circulate among the pipes around the outer circumference of the drum. Opening into the top of the drum is a vapour return pipe *18* provided with a flaring funnel mouth *19* and in the drum below the said pipe *18* is a baffle plate *20*. Entering one side of the body is an inlet steam pipe *21* which is formed with branches *22* and *23* which enter the pipe *18* near its lower end. Juices are admitted to the body through an inlet pipe *24* provided with a valve *25* and may be withdrawn from the body through an outlet pipe *26* provided with a valve *27*. Connected with the body is the usual pressure gauge *28* and thermometer *29*. The case is also provided with sight openings *30* and *31* through which the contents of the body may be observed. In the opening from the bottom of the drum is a condensed steam discharge pipe *32*. Juices to be condensed are run into the body until the drum is covered. Steam is then admitted under the desired pressure and this steam enters the pipe *18* and being directed downward creates a suction in the top of the pipe *18* so as to draw the vapours arising from the juices downward into the drum. The steam heats the drum and the condensed steam is discharged through the pipe *32*. As the juice becomes heated it circulates automatically up through the tubes *14* and downward around the drum and as these tubes are arranged as described, the steam reaches them all with practically the uniform degree of heat, so that the action on the juice is uniform throughout the drum and without the aid of pumps, or other mechanical power to maintain proper circulation.



Manufacture of Alcohol Motor Fuel (or Industrial Alcohol).[1] ***Francisco de Moure Accioly***, of Rio de Janeiro, Brazil. *1,453,374.* May 1st, 1923.

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[1] See U.K. Patent, 187,640; *I.S.J.*, 1923, 163.

Manufacture of Grape Sugar (Dextrose or Glucose) in a Pure State. *William B. Newkirk* (assignor to *Corn Products Refining Co.*, of New York). *1,471,347.* October 23rd, 1923.

In the first place the process involves crystallization so conducted as to produce crystals of relatively uniform size, either hydrated or anhydrous, depending upon the temperature maintained; and secondly, the mother-liquor, or "hydrol," is re-crystallized, so as to product two or three crops. Liquor from the starch converters is passed over char, concentrated *in vacuo* to a density of 38 to 45° Bé., "seeded" with crystals, quickly cooled to 95 to 105° F., and held at this temperature for approximately 30 to 60 hours. The mass of crystals thus resulting is centrifuged to separate the mother-liquor, which is concentrated and submitted to the same operations, the cycle being repeated with the mother-liquor then obtained.

Packing Cube Sugar in Cartons *Guiseppe Iacobitti,* of Crockett, Cal., U.S.A. *1,472,395.* October 30th, 1923. (Twenty figures; seven claims.)

Claim 4 :—A machine for packing lump sugar in cartons comprising the combination with a carton holder of a series of chutes to deliver the sugar lumps to the machine in arranged series, a single chute into which the pile of arranged lumps is delivered and which positions them to be placed in the carton, a plunger for pushing the sugar lumps into the carton, a series of spring-held plates against which the pile of arranged sugar lumps is pushed to prevent the pile of sugar lumps from engaging the sides of the carton, and means to project and retract said plates to pass them into and remove them from the carton.

Recovery of Sugar from Defecation Mud. *Elie Delafond,* of Havana, Cuba. *1,476,152.* December 4th, 1923. (One claim; no drawings.)

Mud before going to the filter-press contains about 10 per cent. of sugar, and the object of this invention is to recover this sugar as a thin juice and return it to the cycle of operations. To this end the mud is diluted with about four times its volume of water (preferably cold, so as to re-dissolve as little as possible of the impurities). The mixture is allowed to settle in the decanting apparatus, and the clear solution is drawn off and used in lieu of water for maceration at the first mill. The mud contains now only about 2 per cent. sucrose, and may be mixed with another 4 volumes of water, allowed to settle, and decanted, this clear liquid also being used for maceration at the first mill. This leaves about 0·4 per cent. of sucrose in the mud. If found practicable the operation may be repeated again to reduce it to about 0·08 per cent. In fact, the washing may be repeated as often as desired. In order, however, to coagulate the albuminoids, and to harden the pectins, and thus to render these substances separable by decantation, a coagulant is added to either the mud or decanted solution, namely, ozone, oxygen, sulphur dioxide or formaldehyde, preferably the last mentioned, in the proportion of about 1 volume of formaldehyde to 25,000 volumes of mud to be treated. These coagulants are mixed with the mud in any well known manner, either before or after dilution, by allowing the coagulants to bubble through the mud while contained in a closed vessel or otherwise. Formaldehyde is preferred for the reason that any excess that may remain in the clear liquor is completely evaporated when the liquid is used.

Alcohol Motor Fuel. (*A*) *J. M. A. Chevalier, P. Bourcel, and Henri Regnault,* of Paris, France. *1,469,148.* September 25th, 1923. (*B*) *W. T. Schreiber,* of Baltimore, Md., U.S.A. *1,469,053.* September 25th, 1923.

(*A*) Claim 1: A process for carburetting alcohol, characterized by the addition to the latter of the volatile spirit of resin, known in commerce under the name of volatile oil of resin. (*B*) Claim 1: A fuel comprising a petroleum distillation, an alcohol, and diethyl ketone.

GERMANY.

PRODUCTION OF LEVULOSE AND DEXTROSE IN THE CRYSTALLINE STATE FROM INVERT SUGAR. *Alexander Herzfeld and Rolf Passer*, of Berlin-Friedenau, Germany. *381,575*. April 29th, 1922. Published, September 21st, 1923.

According to this process, by which from one and the same solution of invert sugar both levulose and dextrose can be obtained in the crystalline state, the levulose is first separated as its calcium salt in the known way, the precipitate washed with cold water, suspended in water, and decomposed with carbon dioxide. During the filtration of the calcium levulosate, the liquid must be kept at a temperature below 10° C.; and, as soon as the precipitate has been separated, the filtrate is cooled. Carbon dioxide is passed into it to supersaturation while maintaining the temperature stated, after which filtration follows. Any calcium remaining in solution, or any that has been re-dissolved, is eliminated by precipitating with sulphuric or oxalic acid and filtering off, the liquid being lastly evaporated, separated at a suitable consistency from the precipitate forming, and allowed to crystallize out at a temperature say of 30-40° C., anhydrous dextrose thus being obtained. It is stated that the yield is almost quantitative.

PROCESS OF BOILING SUGAR IN THE VACUUM PAN. *August Gräntzdörffer*, of Magdeburg, Germany. *381,499*. June 11th, 1921; published, September 21st, 1923.

After grain has been formed in the usual way, and more syrup has been drawn in, the liquid is boiled "thin" until the pan is full (e.g. to a density of 73-82° Brix at 83°C.). This thin strike, which contains 60-65 per cent. of crystals, is mashed in the mixers while adding fine grain; and, after allowing it to crystallize out in the form of a massecuite incapable of being centrifuged in the ordinary way on account of its fine grain, it is treated in an apparatus which makes possible the separation of the fine crystals, such, for example, as those described in German Patents 329,590 and 335,002. A massecuite treated in this way gave 82 per cent. of its weight of sugar, having a polarization of 95·5° and 0·82 per cent. of ash, while the molasses separated had a quotient of 75·3°, as compared with one of 78·2° obtained with a strike boiled by the old process. Since much less water requires to be evaporated from the massecuite (only about one-tenth) than usually, heat and time are economized, besides which less sugar is decomposed as the result of the prolonged action of heat. Lastly, a strike interspersed throughout with fine grain gives a higher yield than one containing the crystals in the form of large grain.

PRODUCTION OF WHITE CRYSTALS FROM RAW SUGARS BY WASHING IN CENTRIFUGALS.[1] *Theodor Drost*, of Germany. *377,458*. November 23rd, 1919 (published August 3rd, 1923).

First-product massecuite is spun in the centrifugals for the liberation of its green syrup, after which the crystals remaining in the machine are clairced or washed with a syrup at such a temperature (between 70° C. and its boiling point), and at such a density (about 70° Brix), that solution of the sugar is avoided. Low-product massecuite may be treated similarly, except that between the operations of spinning-off the green syrup and claircing with the hot heavy syrup, the crystals are given a preliminary washing with molasses at such a density (about 76-77° Brix), and such a temperature (about 70° C.), that the crystals are not dissolved. In both cases, whether the material treated be first-product or low-product massecuite, a white and dry sugar ready for sacking is obtained. Economy of fuel, and the absence of steam around the centrifugal station, are the advantages claimed in favour of this method of working, compared with ordinary procedures using vapour for covering.

APPARATUS FOR CONTROLLING THE ADDITION OF MILK-OF-LIME IN SUGAR MANUFACTURE. *Jan. Plapis*, of Przeworsk, Poland. *378,890*. Published, August 7th, 1923.

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[1] Also French Patent, 527,516.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to April 30th	1.203.952	1,367,346
Deliveries ,, ,,	1,160,320	1,347,580
Meltings by Refiners ,, ,,	1,054,260	1,149,010
Exports of Refined ,, ,,	25,000	75,000
Importers' Stocks, April 30th	44,426	19,766
Total Stocks, April 30th	170,275	226,305
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons.	1923-24. Tons.
Exports	818,697	1,469,037	1,455,575
Stocks	799,619	653,692	660,388
	1,618,316	2,122,729	2,115,963
Local Consumption	30,000	30,000	30,000
Receipts at Port to March 31st	1,648,316	2,152,729	2,145,963

Havana, March 31st, 1924. J. Guma.—L. Mejer.

The European Beet Crop of 1924-25.

F. O. Licht's Estimate of Sowings.

	1924-25 Hectares.	1923-24 Hectares.	1922-23 Hectares
Germany	390,000	338,554	358,339
Czecho-Slovakia	290,000	225,712	164,591
France	190,000	149,848	127,450
Holland	75,000	67,226	55,956
Belgium	85,000	72,264	69,176
Sweden	48,000	43,700	16,716
Denmark	33,000	30,300	24,330
Poland	170,000	141,217	109,353
Hungary	80,000	46,037	28,775
Austria	15,000	12,889	10,584
Rumania	45,000	39,100	22,500
Yugo-Slavia	35,000	28,750	22,000
Italy	95,000	93,000	85,000
Russia	310,000	248,353	175,608
Other countries	114,000	96,187	84,215
Total Europe	1,975,000	1,633,137	1,364,593

United Kingdom Monthly Sugar Report.

Our last report was dated the 12th April, 1924.

The market has continued to decline during the period under review, and although there have been one or two reactions, generally prices are about 3s. per cwt. lower than a month ago.

The terminal market continued its downward path; speculators were chiefly concerned in transferring their May commitments to August, and the difference of 3s.—which existed at one time—is now reduced to 2s. Tenders of about 4000 tons took place in April and, although not in such great volume as in March, the sugar was readily taken up and did not press on the market. April sold from 29s. 9d. to 29s., May from 29s. 6d. to 28s. 3d. to 29s. 10½d. to 25s. 10½d., August fell from 26s. 6d. to 25s. 6d., then recovered again to 26s. 9d., finally relapsing to 23s. 9d. New crop has continued to decline with moderate fluctuations, October/December sold from 23s. 6d. to 21s. 6d., and December from 23s. to 21s. The latest prices are: May, 26s. 6d.; August, 24s. 6d.; October/December, 22s.; and December, 21s. 6d.

Trading in actual sugars has on the whole been poor, but the one prominent exception was when the Chancellor of the Exchequer lowered the sugar duty from 25s. 8d. to 11s. 8d. Naturally, this brought about considerable movement in spot sugars but its duration was short-lived.

The British refiners made various alterations in their prices, which were reduced 1s. on April 15th, a further 1s. on April 22nd, a reduction of 14s. on account of the duty on April 30th, and a further reduction of 1s. on May 5th, making a total reduction of 17s. per cwt. To-day's quotations are: No. 1 Cubes, 46s. 6d.; London Granulated, 43s. 7½d. The refiners have not been very anxious buyers of raws, only a small business has been transacted which comprises sales of Cubans from 24s. to 22s. 6d. c.i.f., and San Domingoes from 25s. to 23s. 6d. c.i.f. The latest prices are 22s. for all 96 per cent.

Foreign Refined has been fairly active and the demand generally speaking has been poor. Large quantities of the accumulated Czecho sugars have been tendered at Hamburg. Czecho Granulated has been sold from 30s. 6d. down to 27s. for ready, May/June, and June/July. Dutch Granulated has commanded higher prices than Czecho but transactions have been limited in quantities. The new feature has been the offering of American Granulated which has come into the market, this sugar has been sold from 31s. to 28s. c.i.f. Business was done in May/June Javas from 25s. 4½d. to 23s., June/July from 24s. 4½d. to 22s., whilst July/August sold at 21s. 6d. A small business has been done in Czecho and Dutch for new crop down as low as 21s. 9d. to 21s. 6d. for November/December.

The market in America has been declining and as the demand for Refined has not been keen the refiners refused to buy freely of raws and Cubans declined from 4¾ cents to 4 cents c.i.f. The Futures market, although at times having fluctuated wildly, has eventually followed the course of actual sugar.

The Cuban crop appears to be progressing very satisfactorily and the news of the recent insurrection in the Santa Clara province appears to have no effect on the grinding of the Centrals. The receipts at the outports to date are 2,835,000 tons against 2,775,000 tons last year, and Messrs. Guma-Meyer have increased their estimate from 3,750,000 to 3,900,000 tons.

With regard to the European beet crop Mr. F. O. Licht still estimates an average increase of 20 per cent. in the sowing, in spite of the fact that owing to the abnormal weather the crop is already three to four weeks late in starting. It is, therefore, quite impossible at the present time to give any reliable estimate of the final outturn.

21, Mincing Lane,
London, E.C. 3.
10th May, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL

SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 306. JUNE, 1924. Vol. XXVI.

Notes and Comments.

The Government's Attitude towards Imperial Preference.

Further consideration of the Labour Budget policy of cutting down Imperial Preference on sugar to an inappreciable figure strengthens the conclusion that from all points of view which matter, it was a wholly unnecessary step on Mr. Snowden's part and was not dictated by any other incentive than a blind adherence to doctrinaire free trade, of which Mr. SNOWDEN is a well-known exponent. He has had no lack of opportunity of listening to an exposition of the larger considerations that render the maintenance of Imperial Preference an urgent matter, for several Unionist speakers, especially Sir WILLIAM MITCHELL-THOMSON, who spoke as an old sugar planter, put the case for the Crown sugar colonists, as well as the claims of the consumer at home, in a clear light. Mr. SNOWDEN brushed aside their main contentions as though these were irrelevant and contented himself with quoting a set of figures which showed to his satisfaction, though not to that of his hearers, that the British West Indian sugar industry had actually done better during the four years before the preference came into play than in the four years after. That was conclusive for his purpose, and when on the top of it he enunciated the view that the elections last December had given the Government a mandate to cancel all existing preferences and import duties, it was obvious that no amount of reasoning would divert him from his set policy. Though the last stage of the Finance Bill has not yet been discussed, it is clear that bar an accident to the Labour Government the Budget resolutions on sugar will be passed, thanks to the support of the Liberal party, whose ideas of cementing the ties of Empire never produce anything of practical value.

The case for the Colonies (as the report of the speeches given elsewhere in this number will show) rests on the fact that any expansion of the cane sugar industry in their midst depends on security being obtained for the capital to be advanced—it takes about three years for new areas to be brought to fruition, and unless there is a margin of preference to balance the debit that is bound to show itself, while a new venture is started and takes time to settle down into full working order, capital will not take the risk of being ruined in the meantime by well-established rivals of the colossal order seen in Cuba. The preference already given for four years has had the result of interesting capital, and new factories have been started or are projected which would, before many more years, have made some difference to the output of British sugar. But a suspicion of uncertainty has never been absent, because it was apparent that only one out of the three political parties at home was prepared to back the idea of preference, and the one thing capital needed and could not get was the stabilization of preference for a decade or thereabouts. The political see-saw at home has now swung over, anti-Imperialists (as we judge them to be) are in power, and the needed stability is shelved *sine die*. It is deplorable, because it was not really necessary, unless indeed it was part of the political price the Labour Government are paying to retain the support of the Liberals; and no better sop in the Budget could have been offered the latter.

Mr. SNOWDEN was also silent—nay, impatient—at the argument advanced that it was advisable in the interests of the consumer at home to broaden the sources of supply of sugar and so save this country from being delivered into the hands of foreign sugar monopolists. Yet this argument goes to the very root of the matter. It is of comparatively secondary importance whether the preference does or does not put extra money into the pockets of the British sugar planters. It is more to the point that they should produce us our sugar. Most Britons would, we suspect, prefer that if the money must go to the planters it should go largely to those of their kith and kin across the seas rather than to foreign countries. After all, we only want to do for our own sugar industry what America does for hers. And we have the like ulterior motive that if it pays the planters well to cultivate sugar, they will continue to do so and will moreover increase their output, in which event we consumers at home will have a larger and better distributed source of sugar to draw upon than would be the case if we left the fiscal encouragement of sugar production to other nations; and the price we pay for it would be more easily kept within bounds. Several speakers on the Conservative side in the House of Commons made no secret of their fear that we were in danger of exchanging the old pre-war monopoly of the German sugar barons for a post-war monopoly of huge Cuban-American combines; and if the latter could come to some arrangement with the Java sugar interests there seems little doubt that the sugar consuming world could be held to ransom, especially in a year when Production did not quite attain to the level of Consumption. If that eventuality ever came to pass, we fear that even a free breakfast table at home would be rather an expensive luxury, and the precedent of war time would be repeated in countless households—the breakfast table would be free but free from sugar.

The Views of the Colonists themselves.

Sir WILLIAM MITCHELL-THOMSON scored rather a pertinent point in his speech when he emphasized the fact that his task of pleading the cause of the Crown Colonies to whom we stood in a peculiar fiduciary capacity should have been undertaken rather by the Secretary for the Colonies and not by a member of the Opposition. He instanced the rule prevalent in some Continental countries where there are Departmental Ministers reporting on the affairs of their Departments to the Chamber of Deputies, and regretted that something similar could not be allowed here under our constitution. We believe that had that been so, Mr. J. H. THOMAS, the Colonial Secretary, would have put in no half-hearted plea for his Department, since he is known to sympathize with its point of view and he is not wedded to Mr. Snowden's doctrinaire views. But politics being what they are in this country, the Cabinet is supposed to endorse the Chancellor's fiscal proposals beforehand, and thereafter no Government speaker can say a word otherwise than of full commendation when the debate is on in the House of Commons.

Since the Colonial Office is thus debarred at least in public from expressing its opinion, it has been left to others to put forward the Colonial view. Since the speeches were made in the Budget debate, there have come to hand in this country the views of various Colonial bodies directly concerned. The British Empire Producers Organization, for one, has not been slow in collecting some of them and issuing these to the press.

This Organization, which represents, among other industries, the principal Associations of Sugar producers in the Empire, has, on behalf of its members, made vigorous representations to the Government as to the disastrous effect of the reduction of the money value of the preference on Empire Sugar. In the course of a letter on the subject to the Chancellor of the Exchequer, the Chairman of the Organization, Mr. **Ben H. Morgan**, pointed out that there is likely to be a grave reaction against the goods of this country in Colonial markets, both by withdrawal of custom and by actual reduction of the preferences Britain now enjoys, unless something is done to implement promises made by previous Ministers to stabilize the money value of the preference. In submitting evidence of the feeling which exists throughout the Empire, the Organization has also laid before the Government a series of cables received from the affiliated Sugar Associations in various parts of the Empire.

The substance of these is as follows. The Australian sugar producers in Queensland consider the reduced sugar preference strikes a severe blow at the Dominions. Any repudiation of this and other Conference decisions must have an oblique effect on the maintenance and integrity of the Empire. The South African Sugar Association which, thanks to the preferences, had begun to develop a considerable sugar export trade to Great Britain, reports that the news has caused consternation amongst the settlers who undoubtedly invested capital on the strength of the preference being stabilized. During the four years that have elapsed since the preference was started their production has increased by 40 per cent. The Chamber of Agriculture of Mauritius representing the production of that Colony, which, it will be remembered, saved the English market from being cornered by foreign control, by selling a very large parcel of sugar to the Sugar Commission in 1920 at a price £40 a ton lower than that to which the world price reached, report that the Mauritius planters are keenly disappointed and dismayed, and fear that the present rate will not compensate them for the overhead advantages enjoyed by foreign sugars in home markets. Their Indian market has fallen under Java control since Mauritius sugar began to be diverted to the United Kingdom during the war, hence the reduction in the preference threatens a reduced output of sugar for Mauritius. The British Guiana Planters Association also reports dismay in that quarter, and avers that large orders for sugar machinery from home have already been cancelled, while a corresponding reduction in the preference given there to British goods is foreshadowed. Finally, the Jamaica Imperial Association states that the reduced preference will have a prejudicial effect on production in Jamaica unless the latter can find new customers. It will probably also result in the withdrawal of the preference now given to English goods. Any decreased production in Jamaica has been due to prolonged droughts. The planters had hoped for stabilization of the preference and as a consequence several new factories have been or are being erected.

The tale is fairly unanimous. Even if it were to be conceded that these messages bore a strain of exaggeration in the consequences they one and all picture, the fact undoubtedly remains that they are agreed that the reduction in the preference bodes them no good and will tend to discourage increased production. For while most of these sugar regions will continue to get along, preference or no preference, there will no longer be the strong incentive to expansion which is so desirable if our sources of sugar are to be spread out and the danger of monopolies minimized. The principal sufferers will as usual be the West Indian industries which are peculiarly liable to weather vagaries and never have any large reserve of wealth to tide them over a disastrous period.

The Beet Sugar Industry at Home.

The position of the beet sugar industry at home under the reduced Excise tax was very well stated in the House by Lieut.-Colonel COURTHOPE. He pointed out that the effect was not so much a case of failure for the two existing factories (and of a third now being erected which, it is hoped, to start working in the autumn) as of the discouragement of capital to embark on further ventures, three or four of which were already provisionally planned for early realization. These plans have now been suspended, at all events till the attitude of the Government towards the infant industry is made clear. The reduced preference of £11 13s. 4d. per ton is not considered sufficient for ensuring that new factories should pay their way at the start, so a good deal depends on how far and in what manner the Government will agree to assist the industry in other ways than through the Excise duty omission. That the Government are sympathetic to the idea is evident from the fact that down to May 27th, when the Second reading of the Finance Bill was taken, Mr. SNOWDEN was unable to announce what the Government's decision was to be. He said he had been receiving representations and deputations from various interests associated with the industry, and was further considering the matter. Ere they came to the Committee stage of the Finance Bill, the Government hoped to be able to state their views on the subject. The Committee stage will not be taken till after the Whitsuntide adjournment, so the matter remains in doubt for a little while longer. Meantime, it is too late to hope for more than three factories at most being at work this autumn; how many more there will be at work in 1925 depends on the practical nature of the Government's further assistance.

The Home Refiners' Point of View.

Before leaving the subject of the Budget discussions, reference should be made to a speech of Sir LEONARD LYLE, who voiced the refiners' point of view. He said he was in sympathy with doing everything possible for agriculture, and it was to his own interest that supplies of sugar should be increased, and if they are increased from this country so much the better. But there was also a sugar refining industry in existence in this country, old-established and capable of supplying 1,600,000 tons of refined sugar per annum. Up to last Budget the beet sugar industry had had a protection given it, up to a polarization scale to refined sugar of over £25 per ton, yet up to a year ago they were not able to make things pay upon that enormous protection. Now they were going to get a scale of protection equal to over £11 per ton. If that was not enough for the industry to make itself pay, he did not think the Government should bolster it up any further. He emphasized the inequality from the refiners' point of view of allowing home beet sugar a remission of Excise up to 100° of polarization, while home refined sugars from foreign raws paid full duty.

But, as we have before pointed out, the inequality is at present more apparent than real. It is a case of fifteen or twenty or if you like thirty thousand tons of sugar on the one hand, and the 1,600,000 tons on the other. When and if the home beet industry attains appreciable proportions and has every appearance of being stabilized, it will be time to adjust this inequality and give the refiners like terms, so far as the difference between raw and refined sugar is concerned. But while the refiners can and do refine a million tons or more of our home consumption, the effect on them of the diverting of a few thousand tons to another source of production, run on more favourable terms, is infinitesimal. The real danger to them, which Sir LEONARD LYLE did not see fit to mention, is that a modern beet sugar factory can and generally does turn out ready refined sugar in one operation and thus is independent of the old-established refineries. If we once developed a large beet sugar industry at home, it would make a difference to the amount of raw sugar going to our refineries; unless indeed, as they might one day be forced to do, the refiners run their own raw beet factories and refine the product thereof in their refineries. Hence the danger does not lie in an unfair incidence of taxation at the present or any future date, but really in the encouragement of an industry which can turn out direct consumption sugar in one establishment instead of in the older arrangement of two. And the danger does not threaten merely from the beet industry, but also from that of cane, the experts of which are steadily working for the satisfactory solution of producing a perfectly refined sugar in one operation.

The Cuban Insurrection.

Earlier reports reaching this country with regard to the insurrection in Cuba were decidedly meagre and spoke of a press censorship that rather implied a fear of publicity of the real extent of the trouble. We are therefore glad to learn from later accounts that the insurrection has been more or less kept under. According to the *Louisiana Planter*, the outbreak was the long anticipated revolution that has been engineered for some months past by a so-called Association of Veterans and Patriots. It started by a number of troops stationed at Santa Clara deserting with their equipment and taking to the woods where they were joined by a considerable number of civilians from the surrounding districts. The Government, however, took prompt action and rushed troops to the area affected and these have been busy endeavouring to surround and put an end to the activities of the rebels. Simultaneously a number of arrests have been made in Havana of prominent men known to be connected with the movement through the above-mentioned Association, and the individuals concerned have been lodged in gaol. The press censorship has, however, continued more or less rigidly, so that full details will probably not be known just yet. Our contemporary reports that if the public in Cuba have been correctly informed of the extent of the outbreak, there is reason to believe that the rebellion is not sympathized with by the majority of the people, and that the active measures of suppression taken by the Government will prevent it becoming of sufficient importance to prove a source of any great loss or danger to the island.

At the same time, it is apparent to students of the situation that this insurrection was not hatched without some cause at the back of it. Political affairs in Cuba have not been of the most harmonious nature of late years and there have been repeated attacks made on the Government by opposition politicians in criticism of its conduct of affairs. Discontent has been rife in many quarters and not getting its remedy one must assume that the present insurrection is an outcome so far as the more unruly inhabitants are concerned. The remedy lies with the Government and they will be wise to endeavour to remove the causes of discontent rather than confine themselves to a rigorous suppression of their opponents. Cuba's prosperity is so bound up in her agricultural industries, in particular in sugar and tobacco, that it is rank folly to jeopardize it through inefficient government.

Fifty Years Ago.

From the "Sugar Cane," June, 1874.

Dr. **Frederick W. Griffin** read a paper before the Society of Arts, London, on the Sugar Industry, in which from the technical point of view he gave a very good account of the state of sugar manufacture and refining at that time. He made a plea for scientific control, and drew attention to the poor extraction, inefficient clarification, losses in operation, and other defects, that then obtained to what is now considered an extraordinary extent in those days. Finzel's refinery at Bristol appears to have been conducted on the most progressive lines, and the granulated sugar produced by them had been certified by Dr. **Hassall**, the well-known analyst, to contain 99·9 per cent. of sucrose, the difference from 100 being composed of 0·08 per cent. of moisture and 0·02 per cent. of ash only. Loaf sugar was not so pure as granulated, which was then displacing the older product on the market.

A paper was published on the "Analysis of Animal Charcoal" by G. **Combe Stewart**, of Greenock, and the methods described for the determination of water, carbon and organic matter were practically the same as those used to-day in refinery laboratories, though none was given for the determination of carbonates, sulphates or sulphides.

At that time Lagrange's process for the purification of syrup in refining was attracting some attention on the Continent. It consisted in the treatment of the product at 20°Bé., first with phosphate of ammonia, and then with baryta, the result of the double treatment being claimed to be the elimination of calcium sulphate and other mineral matter, as well as organic impurities, to an extent that largely increased the yield, especially in the case of third syrups and lower products.

A translation of a paper published in the *Journal des Fabricants de Sucre de France* on the "Valuation of the Produce and Loss in the Manufacture of Sugar" showed an appallingly inefficient state of working in the manufacture of beet sugar, assuming that the figures shown were representative. Only 56·4 per cent. of the sugar in the beets found its way into the bags, and the 43·6 per cent. lost was made up of 15·1 per cent. in the pulp and scums, 0·8 at the filters, 3·4 during evaporation, 22·3 in the molasses, and 2·0 in the charcoal. The author of this paper rightly remarked that "it would be in the interest of our industry that researches of this kind should be proceeded with," and he advocated the collaboration of the engineer and the chemist in order to "banish this deplorable routine."

Extracts were reproduced from Dr. Smith's book on "Foods," which was recognized as a standard work at that time, and some of the statements made were as follows: "It is impossible to estimate the entire withdrawal of one important article from the food of mankind; but it may be doubted whether the loss of any one element would be so keenly felt as that of sugar . . . . . Sugar is the most striking illustration of a respiratory food which we possess, for not only does it exert a great and rapid influence over the respiratory process, but it is itself entirely transformed into carbonic acid and water. . . . . . Its action is very rapid, commencing within 5 to 10 min. after it is eaten, attaining its maximum in about 30 min., and disappearing within two hours. . . . . ."

Imperial Preference and the Sugar Duties.

Further Speeches in Parliament.

The Budget came up for further discussion on May 6th, when the Report stage of the Budget Resolutions was taken in the House of Commons; and this gave the Opposition an opportunity to emphasize their previous objections to the reduction in the Imperial Preference on sugar. Below we give selections from the principal speeches made.

Sir WILLIAM MITCHELL-THOMSON, who spoke as an old sugar planter, moved amendments to the sugar duty resolutions, the purport of which was to maintain the preferential duty on Empire sugar at the existing figure rather than at the reduced one of one-sixth of the reduced duty, viz., at 4s. 3½d. instead of at 1s. 11½d. He reminded the House that it was a recommendation of the Imperial Economic Conference that the sugar duty should be stabilized at this larger figure of preference over a period of ten years. Unlike most of the other preferences recommended, the sugar preferences affected the trade relations between this country and, almost exclusively, the Crown Colonies, and in regard to the latter the Government and the House of Commons occupied a peculiarly fiduciary capacity, and he thought that the Secretary for the Colonies ought to be representing the interests of those Colonies instead of leaving it to the Opposition to state the Colonies' case to the House. The case of the Colonies should be well known to the Government, because numerous official resolutions had been sent home to the Colonial Office asking on behalf of the various West Indian Legislatures that the sugar preference be maintained at 4s. 3½d. per cwt.

To show our continued dependence on foreign sugar, the speaker gave the following statistics:—The world's production of sugar in 1913 was 18,436,000 tons, of which we imported here in Great Britain 1,971,000 tons. Of that world's production in 1913 there was produced outside the Empire 82 per cent. Of the sugar imported into the United Kingdom there was produced outside the Empire 96½ per cent. In 1923 the world's production of sugar was 18,038,000 tons, while we imported during the same period 1,568,000 tons. Of the world's 1923 production 78 per cent. was produced outside the Empire, while the United Kingdom imported 67·9 per cent. For our sugar supplies in this country we were thus dependent as consumers on foreign sources for two-thirds of our requirements, with this distinction as compared with the pre-war period that whereas in those days the foreign supplies were Continental, they are now Javan and Cuban. Just as in the old days Hamburg was predominantly the leading market, now it is Cuba and New York which dominate the fiscal position and very largely set the tone of the world's markets. He agreed that the crop next year would be something over 19,000,000 tons, but was afraid it would be fully offset by increased consumption. A great many people in the trade were dubious, and personally he was very much afraid that a not inconsiderable proportion of the remission of duty was going, in December and January next, into the pockets of the Cuban producer.

Turning to the effect on the West Indian Colonies of the reduction in the preference, he averred that the taxation which is being borne by sugar producers there—Imperial and local—amounts to about £4 per ton of sugar made, while the preference was to be reduced to £1 13s. per ton. He affirmed that if we were going to have a preference at all it ought to be an effective one. As to the effect of Preferences on West Indian production, he pointed out that the imports of Empire sugar into this country in 1913 were 71,000 tons; in 1919, they were 298,000 tons; and in 1923, as much as 414,000 tons. Preference has led to a steady growth and a very satisfactory progression since 1919, and it is important now not to do anything to check that progress. The effect of the reduction in preference does not so much hit the existing estates or the highly cultivated lands or the factories already built as make it extremely difficult and almost impossible to start new developments. It takes at least three years to bring land from the condition of the jungle to that of sugar in bags.

On last year's figures the cost of the Chancellor's proposal would be about £800,000, against which must be set off the extra revenue derived from a tax on receipts from investments of British companies in new sugar development operations in the Colonies, and also the receipts from taxation on the profits of makers of sugar machinery and equipment.

As compared with the preference of £1 13s. 10d. per ton which the Budget proposed to allow the British West Indies, he pointed out that the United States gave Porto Rico a preference of £10 5s. per ton and even our beet sugar industry at home received £11 13s. 4d. per ton. Such a glaring contrast could not fail to have a bad effect upon the West Indies. And in proportion as we have a deficiency in the supply of sugar in those markets, we have to make it up by the purchase of foreign sugar.

The employment question at home was also affected by the new Budget proposals to the extent that in the making of machinery at home for a 10,000 ton factory there was work provided for 500 skilled engineers for six months, and it was precisely in that class of work that we were experiencing at the present time the greatest difficulty in regard to unemployment.

Mr. Ormsby-Gore said that the worst feature of the Budget was the repudiation by the Chancellor of the Exchequer of this country's responsibility to the sugar-growing Colonies. It had happened before in the days of the sugar bounties when we had to pour out millions for grants-in-aid to help those same Colonies. When he visited the West Indies recently the one demand from all sections of the population was for the stabilization of the preference. The Government were going to set the clock back and make this country dependent on trusts and combines who were able to manipulate the price to the consumer in this country. One of these combines had £7,000,000 invested in a group of factories. Combinations of traders in the United States were being formed in order to market the surplus sugar in different countries in Europe. As an instance we had the Sugar Export Corporation formed for the express purpose of dealing with Cuban and Porto Rican sugars in bond and marketing the refined product in Europe. The Chancellor of the Exchequer was placing the consumers of this country under the heel of such combines at the very moment when he had a chance of enormously increasing the British sources of supply.

Mr. Snowden in reply reminded the House that we had had a General Election following on last Autumn's Imperial Conference where those preference resolutions were the great issue before the country, and that by the verdict of the electors the position of the parties in the House had been changed. He suggested that the amendments of Sir William Mitchell-Thomson were proposed in the interests of the West Indian planters at the expense of the sugar consumers of this country. Every penny of the preference hitherto, he considered, had gone to increase their profits. Here Mr. Austen Chamberlain interpolated a question as to whether it was not advantageous to the British consumer that he had a wider supply from which to draw, and that a British and not a foreign supply; to which Mr. Snowden retorted that that was an argumentative point which was not a fit subject for interruption. He disputed the value of the figures put forward by Sir W.

MITCHELL-THOMSON as showing the increase in Empire sugar under the preference. He classed it as a favourite Tariff Reform argument—the fallacy of percentages. His own figures showed that in the five years of preference between 1919-20 and 1922-23 there had been an increase of less than 100,000 tons in Empire-produced sugar. As for the West Indies, in 1919-20 they produced 191,000 tons and in 1922-23 this had fallen to 159,000 tons. Never since the preference began to operate, he declared, had the annual production of sugar in the West Indies reached the figure at which it stood in the four years before the preference began to operate. The figures in thousands were: In 1916 it was 195, next year 180, next year 197, next year 191. Then the preference began to operate and it dropped down to 143, dropped again to 166, then 159, and the provisional estimate for 1923-24 was 166. Need he say another word? The whole case was destroyed by hard facts.

Viscount WOLMER, who followed the Chancellor, characterized the latter's speech as lamentable. He had taken the figures for West Indian production starting from a year which was at the height of the war, when sugar was commanding prices which it could never since command and is never likely to command, and then when he found that there had been a reduction which was partly accounted for by difficulties of agriculture, he asked the House triumphantly: "Need I say another word?" Surely this was a totally inadequate attitude for the Chancellor to take in dealing with so great a problem. He had not attempted to deal with the necessity for widening the area of sugar supply within the Empire. He (Lord WOLMER) agreed that the preference benefited the producer in the West Indies but it would also benefit the consumers in this country.

Lieut.-Colonel COURTHORPE voiced the view of those interested in the beet sugar industry at home and deplored the reduction in the duty on sugar as it affected the amount of the preference received by the home product. He said that we had two factories already at work and a third was being erected and it was hoped would be at work in the Autumn. But a few months ago we had on the stock three or four other factories, two of which would have been ready to deal with the crop of this year. Those factories had now been put back, because the capitalists who had provisionally undertaken to provide the capital for them declined to do so for fear the protection which the infant industry enjoyed might be withdrawn by the present Government. Whether that capital could be made available by some other means he did not know; but it was certain that unless some assistance could be offered by the Government in substitution for the protection that the Budget was withdrawing, those additional factories would not be erected. Personally, he believed that when once the beet sugar industry in this country was fully developed and tuned up to concert pitch, it could flourish without fiscal protection. But a new factory could not possibly pay its way or carry on other than at a loss for some years under the state of things which the Budget was establishing. It took a farmer years of experience before he could grow beet to the best advantage. It took years also before the transport and handling of the sugar crop could be brought up to economic perfection. And when you got to the factory, which had to work continuously day and night for about 100 days, it could not be expected to do that efficiently unless it was tuned up to the highest pitch of perfection. As an instance experience showed that till the farmer was an expert cultivator too many stones got carried into the factory on the roots, to play havoc with the slicing machines, and in some cases brought all the latter machines to a standstill, with a consequent loss to the factory efficiency.

In the end, the amendments proposed by Sir W. MITCHELL-THOMSON were defeated by 243 votes to 182, a majority of 61.

The Australian Sugar Industry.

Interesting Results of a Dry Year.

By T. D. CHATAWAY.

In my last review of the Australian sugar industry I said, "One anticipates some remarkable figures from the present harvesting season, when the results become known." I am disposed to think that forecast was not exaggerated. As a rule, the crushing season seldom goes beyond the end of December, but in the present case we actually had one mill taking cane up to the end of February. We must therefore take the official figures of the results of the season as preliminary only. These were published soon after the close of the year, and may be summarized as follows:—

	Acres Crushed.	Tons Cane.	Tons Sugar at 94 n.t.
No. 1	60,680	1,120,000	154,076
No. 2	52,272	508,168	67,154
No. 3	28,407	296,068	34,868
No. 4	2,958	59,227	6,877
Total for 1923	144,317	1,983,463	262,975
„ 1922	140,850	2,167,990	283,785

To make matters clear it should be repeated that the area under cane in Queensland is divided into four divisions, viz.:—

No. 1.—Rockingham, which includes everything north of Townsville.

No. 2.—Edgecumbe, from Townsville to Mackay.

No. 3.—Wide Bay, from the Tropic of Capricorn, south to about 26°.

No. 4.—About Brisbane and called Moreton.

In addition, to complete the Australian output, there are the northern rivers of New South Wales, and the beet sugar industry of Victoria. These, according to the annual report of the Australian Sugar Producers' Association, yielded:—

	1922. Tons.	1923. Tons.
New South Wales (cane sugar)	17,750	16,100
Victoria (beet sugar)	1,861	2,784
Total	19,611	18,884

or a grand total for all Australia of 281,859 tons during the past year, as against 303,396 in 1922. Seeing that at the end of June, 1923, there was a carry-over approximating 57,000 tons, while the consumption is only about 280,000 tons, Australia was able to supply her own wants, export, as we know, about 20,000 tons, and still have in hand the usual carry-over until the 1924 sugar becomes available.

EFFECT OF RAIN SHORTAGE IN THE TROPICS.

The results of the past season undoubtedly surprised the most optimistic. It was felt that the dry season would give richer cane, but if there were quality it was believed that quantity would be entirely lacking. In order to see what happened and what relation the rainfall bare to the results I have made the following tabulation.

Looking over this table with some knowledge of the localities we find that Babinda with a rainfall 33 per cent. below normal made the record crushing for Australia, the output of the mill being 22,000 tons of sugar of 94 per cent. net titre. Turning up the monthly records we find that throughout No. 1 division there was an entire absence of the heavy tropical rains, "soaking the ground against the terrific evaporation," as we used to say, and quite moderate rains have given very excellent results. This year the usual monsoonal rains have fallen, and it will be interesting to watch the results early next year. Turning to the other divisions we find No. 2 in very poor shape, and No. 3, each getting further south and therefore nearer to cool climatic conditions, even worse. With some the rainfall was quite deficient, but generally it may be said that the growing weather which stood by No. 1 was absent in the case of the divisions further south. The case of Moreton, or No. 4, stands quite by itself in an abnormal year.

		Annual Fall. Average.	Year's Fall. 1923.	Tons Sugar per acre.		Tons Cane per acre.	
				1922.	1923.	1922.	1923.
No. 1 Division	Babinda	157·47	104·26	2·27	2·55	16·26	18·45
	Cairns	89·86	53·55				
	Innisfail	146·05	90·88				
	Mossman	93·67	55·88				
	Port Douglas	80·64	40·57				
	Ingham	80·22	39·01				
No. 2 Division	Ayr	43·58	11·35	1·79	1·28	13·49	9·72
	Bowen	40·14	11·30				
	Mackay	68·58	31·85				
	Proserpine	75·05	27·49				
No. 3 Division	Bundaberg	43·56	28·84	2·05	1·22	16·59	10·22
	Maryborough	45·62	42·06				
	Childers	41·62	29·41				
No. 4 Division		61·38	60·24	2·37	2·32	20·26	20·02

The figures speak for themselves. The annual rainfall was equal to the average, the production of cane to the acre and also that of sugar barely a fraction out of the normal. A point of interest suggests itself in the above figures. We know that in a typical district like Mackay the annual average rainfall used to be over 80 inches. That was before the heavy scrub timber was cleared off the coastal hills. The average now is down to less than 70. If that is due to the denudation of the hills, the same results should operate farther north. Mackay suffered last year because it did not receive an average rainfall, but barely one-half the normal. Further north, where the same destruction of timber has taken place, there is evidence that better results can be secured with less than the usual rainfall. In the face of the figures and the experience there seems no reason to anticipate disaster from the clearing of the tropical scrubs, even if that does minimize the volume of the monsoonal downpours.

THE MATTER OF THE MARKET.

The control of the selling of the sugar output by a pool is giving satisfactory results. It is hardly necessary to say that much depends upon those in control, because they must be inspired with courage to face the possibilities of the future which is by many depicted in the gloomiest possible aspect. Further the controllers must be prepared to take every opportunity to keep the Australian market free from over-supply. Thus the other day the pool management sold 9700 tons to London, and 6000 tons to the Colonial Sugar Refining Company for its New Zealand trade. This last transaction is of interest as the Company's output from its Australian mills goes into the pool, and in this case it has actually had to buy back again a portion of it. It is calculated that in the ordinary course of affairs the consumption of sugar in Australia will increase by from 5000 to 6000 tons per annum, and to this must be added any increase in sugar used in making jams, confectionery, preserved milk, etc., for export. The cable announcement that the

British Premier has declared himself against all Empire preferences is calculated to cause anxiety seeing that it will deprive Dominion sugar of the advantages which it now enjoys by the rebate on sugar contained in jams, etc. imported into Britain. Several applications have been made to the Queensland Government for additional crushing power, but these have been refused ostensibly because the future of the market is uncertain, but very probably because the Government cannot see its way to find the large sums of money involved in erecting new factories. It is a startling commentary on the popular theory of the white man in the tropics that European cane growers are clamouring in the most humid belt of the Australian tropics for the right to grow sugar cane with an assurance that it will find a market.

DE-SOCIALIZING A FACTORY.

The Babinda factory, which cost about half a million sterling was erected by the Queensland Government together with the necessary adjunctive offices, and a large hotel, with all modern conveniences, for the use of the employees and neighbouring settlers. The cane was at once forthcoming to supply it up to a capacity of 15,000 tons of sugar, and as already noted this season the mill has manufactured 22,000 tons. The Government is called a Labour Government and it was assumed that its erection of the factory and its control was intended as a sample of what a Socialistic Government would do. Considering the large output, however, the cost of operating seemed excessive, as compared with some of the mills over which the Government had no control, and the farmers supplying the mill approached the Government and asked that it be transferred to them, they taking over all the assets and liabilities. The Premier, Mr. THEODORE, was quite willing, and made out a set of conditions, which would keep the mill really in the hands of the farmers, and prevent it drifting into the control of speculators. A vote of the farmers interested by an overwhelming majority accepted the proposals, and since then directors have been elected, and the sole interest of the Government has been reduced to that of mortgagee. The South Johnstone mill is also a Government venture, and probably the farmers will take it over in due course. Then there will be the Tully mill, the £750,000 proposition, which is expected to be at work in 1925. Should the Queensland Government remain in the same temper, this also may pass under the control of the farmers as a co-operative Company. Socialism of this sort appears to have a good deal to recommend it.

GOVERNMENT SCHOLARSHIPS FOR THE INDUSTRY.

The Sugar industry in Queensland is easily the largest employer of labour and is certainly the backbone of the State's prosperity. The Government has recognized its value, and has taken sensible steps which may lead to most important and desirable results. The proposal provides for three travelling scholarships, each of the value of £300 a year, tenable for four years. One Scholarship will be for sugar engineering and chemistry, one for plant pathology, and one for soil problems. The holders will spend the first year studying their subject in Queensland, and then proceed to such places and institutions abroad as the Minister for Agriculture may decide. Each scholar will be required to sign an undertaking to enter, at the expiration of his term, into the employment of the Queensland Government for at least four years, with remuneration of not less than £300 a year. Immediately the proposal was known there was a rush of applicants, mainly young university students with a B.Sc. degree, and three were at once chosen. The Council of the Australian Sugar Producers' Association was so well-pleased with the Government's action that it at once decided upon a fourth scholarship which will be given at the expense of the Association.

The Australian Sugar Industry.

UTILIZING BY-PRODUCTS.

The future of the white cane sugar industry is slowly unfolding itself before the eyes of those who believe in its possibility, provided always that science and mechanical invention is brought in to take the place of coloured labour. In the case of the sugar beet it is recognized that that industry would be unpayable, were it not that so much more is made out of it than actual sugar. From the earliest days the cane sugar industry has depended upon its sugar product to pay all expenses and make somewhat hazardous profits. There was a time when molasses went to make rum, but not in very great quantities, and an effort was made to combine molasses and bagasse into a form of easily portable horse-feed. But it cannot be said that these were very serious efforts to make profitable the by-products of the industry. For some time there has been an agitation afoot to make better use of the molasses, which have been partly utilized as fuel, partly to feed horses, and sometimes as a fertilizer. The distillation of power alcohol naturally suggested itself, though those interested in the cost of petrol gave little encouragement because if all the molasses produced in Queensland were converted into motor spirit the quantity produced would only supply the requirements of the State, namely less than 4,000,000 gallons! In the sugar districts, however, where motor traction is becoming the general practice the supply of spirit on the spot offers great advantages and economy. The difficulty in the way has hitherto been the matter of cheap denaturation, the Commonwealth insisting upon a formula which adds heavily to the cost of alcohol which has been made non-potable. Happily a solution is now in sight. During the war the Commonwealth erected on the Brisbane river a factory for the manufacture of acetate of lime, and drew its supplies of molasses in tank steamers from Cairns. With the end of the war the factory became useless, but experiments were carried out, and the Government has now decided to use it for the production of motor spirit, not to compete in the open market with other spirit, but to supply the thousands of motor vehicles used by the postal and other departments. This, of course, thrusts upon the Commonwealth Government itself the necessity of solving the problem of cheap denaturation, and the manufacture of a spirit which will not corrode or otherwise injure motors. Should the scheme operate successfully the farmers will soon want their own sugar mills to add distilleries to their plants, and with cheap and accessible power the use of motors and tractors will become increasingly popular, and it is not impossible that even such a revolution may be brought about that the horse with all his expenses of feed, shoeing and harness will practically disappear from the canefields. At the present time the greater part of 50,000 tons of molasses is wasted in a good season; but this is worse than mere waste. The mills are not permitted to run the stuff into rivers and other places where they might destroy fish or create a nuisance. Consequently they have actually to spend money to waste the valuable product. Every ton represents 65 gallons of alcohol, so that not only would the expenditure in wasting be saved but there would be an additional income of something like £400,000 a year, and the economies in the field already mentioned. But we seem on the verge of still further use of our by-products in the manufacture of boards out of bagasse. The latter is at present burnt in the furnaces, and it may be said to supply the bulk of the fuel required by the mills. It leaves the rollers and is automatically fed into the furnaces, and thus has many advantages. If it is to be made into Celotex, the name given to the building and insulating boards which it produces, then a substitute fuel must be found. This should not be difficult if alcohol were used as a fuel, or the feverish search now going on in Australia for natural oils were successful. News from America is to the effect that a Celotex plant, to cost £250,000, is now in course of manufacture in New Orleans and that it is to be sent out to Queensland. There is nothing very definite known in Australia, except possibly by the Colonial Sugar Refining Company. We can only wait and see. It is claimed in Louisiana that the local plant has proved highly profitable from its inception and is now being duplicated. There are no technical details available, but the methods seem simplicity itself. The bagasse as it leaves the mill is baled, and conveyed to the Celotex factory by rail, where it is treated much as wood is in the making of paper pulp. Apparently the margin of profit is considerable, as mention is made of the intended importation of bagasse from Cuba for the purpose of increasing the American factories' supplies. Thanks to the nearly completed coastal railway from Cairns to Brisbane the whole of the sugar districts will shortly be linked up and a check put upon the inordinate charges for sea carriage. With the profitable use of bagasse and molasses the Australian sugar industry should be able, if necessary, to exist with its chief product at a much lower level than at present.

THE FOREIGN ELEMENT.

No review of the past few months would be complete without some reference to the agitation which is growing in the sugar districts against the white foreigners. It is hardly justified by their numbers, but rather by their conduct. It is freely asserted that a lot of these men have joined the local labour unions, and sums of money have come into their possession which it is asserted have their origin in the Third International of Moscow. Probably of all the foreigners those bitten by the Moscow microbe are comparatively few. We had a sample of their work at Mourilyan in 1922, when the men on the wharves held up shipment for so long that it cost several thousand pounds to recondition the sugar which was delayed in transit. While the greater number of farmers in the Herbert district is a very good class of Italians, the absence of British cane-cutters is attracting attention. Mr. H. T. EASTERBY in his annual report as Superintendent of the Bureau of Sugar Experiment Stations has presented a table which is very liable to mislead. He takes the figures of what is known as the Rockingham division, omitting the Burdekin section, where practically all farmers and labourers are British, and he shows that in the balance of the division there are 981 British and 482 non-British farmers, while the cane-cutters number 1269 non-British against 687 British. He estimates that of all the farmers in the sugar districts of Queensland less than 10 per cent. are non-British, and it would have been interesting had he given us a similar calculation in regard to cane-cutters. The last Royal Commission which investigated the sugar industry stated the total number of cutters in Queensland at 6100. Mr. EASTERBY says that south of the Herbert the foreign settlement is negligible, and, as for the most part where we find non-British farmers it is there we find non-British cane-cutters, we may assume that of all the cane-cutters not much more than 25 per cent. are foreigners. The objection the British workers have to the foreigners is not so much on account of their nationality, but because they are alleged to work below the rates of pay fixed by industrial awards. It should, however, be pointed out, that the number of white men engaged in the industry includes many who are neither farmers nor cane-cutters. Field hands and carters number 4000, while those employed in the raw sugar mills are calculated as numbering 5600. There are practically 10,000 white men, in addition to the cutters and farmers, against whom the charge of being non-British cannot be laid. One thing seems obvious, namely, that if we insist upon having a white tropical industry we cannot hope to restrict white men to persons of our own nationality.

Scientific Research in Connexion with the Sugar Industry.[1]

By R. G. W. FARNELL.

NECESSITY OF RESEARCH IN THE SUGAR INDUSTRY.

When we turn to the sugar industry, and especially the cane sugar industry, we find much the same condition as that of a man living on his capital. In most fundamental respects the manufacture of raw sugar is the same as nearly 50 years ago. Defecation of cane juice by the application of lye and heat was practised by the Egyptians in the eighth century. The original process is still used in India and China for the manufacture of jaggery. Wood ashes were superseded by lime about the year 1750, and lime still to this day remains the only substance in general use. Steam heating was first employed in 1785, and 3-roller mills were introduced in 1794, and are still seen in operation. Evaporation *in vacuo* was invented by HOWARD about the time of Waterloo, while multiple effect evaporation, a most fundamental advance, was the product of a French genius, DEGRAND, in 1836. In 1846 a patent was granted to HARDMAN for protecting his invention of the centrifugal, which he termed "molasses-disperser." Wood charcoal was first used in the industry in 1812, while in 1815 MARTINEAU patented the use of animal charcoal for refining and clarifying sugar. Sulphitation, suggested by PROUST in 1809, was introduced into the industry by MELSENS in 1849. Carbonatation, originally used in the German beet factories, was extended to the cane industry by PELLET, and was working in Java in 1878.

After this recital of dates one cannot dispute the fact that for the last 50 years the sugar industry generally, and the British especially, has been living on the capital of their forefathers' inventive genius.

Let us now examine a few other industries. Take, first, the case of rubber. Although chemical and physical research into rubber only began about 1909, great strides have been made in our knowledge of the properties of raw rubber and vulcanization. Much the same tale can be told of the automobile industry, the photographic industry, while such discoveries as that of manganese steel by HADFIELD can only be classed as epoch-making. The enormous dye trust, familiarly known as the "I. G.," could never have attained to the position of a minor power but for the constant unceasing prosecution of research carried out both in University laboratories and special laboratories attached to the dye works. Incidentally, this organized chemical research enabled Germany through the I.G. to produce not only all the synthetic ammonia and nitric acid necessary for explosives, but also practically all the chemical products needed during the war.

And what research has been done in connexion with the British sugar industry during the last 50 years? From the biological side the history is not so disheartening. We need not refer here to the discovery of seedling canes, and the work of HARRISON, BOVELL, and BARBER, known all over the world. But with regard to the general ecological study of the cane, we have left too much to the Dutch.

For systematic investigation on the manufacturing side, with one or two notable exceptions (such as NOËL DEERR), we have been content to rely on the efforts of the Dutch, Americans and Germans, and not only for research but also often for the supply of trained technologists to operate our factories. As an instance of our wholesale neglect of scientific research, the case of the Uba cane in Natal affords a good example. Although this cane seems immune to Mosaic disease, yet in Natal at any rate the juice is of such a poor and unworkable quality that at a recent meeting of the Sugar Association of South Africa it was stated that reliance on the Uba cane was a handicap of from 15 to 20 per cent. Yet there has never been made a systematic investigation of the exact character of Uba juice, which may or may not differ fundamentally from the juice or cane of the Bourbon type. Again, the Uba cane in Natal may not be identical with the cane that goes by that name in the West Indies, and here a morphologist is necessary to settle the taxonomic description of sugar cane varieties.

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[1] Paper read before the West Indian Agricultural Conference, 30th January, 1924, here abridged.

Having touched briefly on the need for extended research in the British sugar industry, an account may now be given of the recent development in England of State-aided research and its effect on industry generally and especially that of sugar.

THE BRITISH EMPIRE SUGAR RESEARCH ASSOCIATION.

Early in the war it became apparent that the economic battle after the conclusion of hostilities would be as intense and important for British as were the military engagements to which she was then committed. Consequently, there was appointed in 1915 a small advisory council to report on the methods by which scientific and industrial research could be developed. As a result of their recommendations Parliament instituted a Department of Scientific and Industrial Research, and voted a large sum for aiding research. The function of the Department was to encourage and partially organize the research in three directions:—(1) The encouragement of research workers by grants; (2) the organization of research by industries; and (3) the organization of national research.

We turn to the second function of the Department. The Department decided to encourage industries to organize themselves for the purpose of carrying out co-operative research. Thus the scheme was instituted for the establishment by industries themselves of non-profit sharing companies, registered under the Companies Act, and having powers to research and to aid education. These companies are known as Research Associations. Before a Research Association can obtain a grant from the million pounds specially allocated by the Department, guarantees must be given that the work shall be continued for five years. Also the Department insisted that the members of a Research Association should raise among them a minimum income, the amount of which varied with different industries. Against this income it made a grant of pound for pound. The Department laid down that at all times the Research Association was to have a director of research, and that a general research programme must be drawn up. Information gained by the Research Association was immediately to be put before its members. After an interval it could be published in the usual technical journals. If, however, an important discovery was made which would have immediate application it was to be reserved exclusively for the members, and not be made available to the general public until a sufficient time had elapsed in order to guard the members' interests. Regarding buildings and laboratories, the Associations were advised to make as much use as possible (at any rate during the first stages) of existing institutions, and later, when funds permitted, a separate research institute could be built.

The British Empire Sugar Research Association received its license in 1919. The aims of the Association were to establish, in co-operation with the Department of Scientific and Industrial Research, an Empire scheme for the scientific investigation either by its own officers or by Universities, Technical Schools, or other institutions, of the problems arising in the sugar industry, and to encourage and improve the technical education of persons who were or were going to be engaged in the industry. Unfortunately, the appeal for subscriptions coincided with the slump in sugar, and it was soon evident that the original scheme would have to be modified considerably. At the end of 1921, however, a start was made on a very modest scale, and it was decided to employ a research chemist who has visited the West Indies. That is the present position of the Association. Its activities, though restricted, have not by any means been suspended and a study has begun of the various colloids of cane juice, to which reference will be made again.

LINES ON WHICH THE ASSOCIATION SHOULD BE DEVELOPED.

Now in the organization of research there are two methods. The first is to make a frontal attack on problems, that is, by the methods based on the experience of the past, without necessarily studying the fundamental nature of the processes involved. This has been the practice adopted almost without exception in the sugar industry, to tackle problems as they arose. Manufacturing difficulties nearly always devolved on the factory chemists, who, too often, had neither the time nor the training to elucidate the true nature of the problem involved, and push it to its successful solution.

The second method is more general in scope and relies, in the first instance, on increasing our knowledge of facts. At this stage the research is more in the realm of pure science. Having discovered what are the true facts, we can apply our new knowledge and devise practical means to solve the original problem. The frontal attack is not so successful in the long run as the second method, which we may call the flank attack. It is the method by which the Sugar Research Association intends to benefit sugar industry.

Let us now consider the organization of the Research Association which the British sugar industry deserves, and which, but for unfavourable circumstances, it might have got. We are at once involved by the very nature of the industry, including, as it does, both self-contained estates all over the world, and the refineries in England and Scotland. We may lay down the following requirements for the proposed Research Association:—

(1) An experimental station somewhere in the tropical or sub-tropical Empire, in close proximity to some existing institution equipped with laboratories.

(2) In connexion with the Experiment Station, a small model factory to investigate new and existing processes for the manufacture of sugar and disposal of by-products.

(3) A laboratory in England to study the many subsidiary problems of the industry, especially those of the refiner. In association with this laboratory it would be necessary to have a records office and intelligence bureau.

At the Experiment Station and in connexion with the laboratories we could investigate the nature and nurture of the cane. By nature we must include the inherited tendencies of the cane, such as resistance to disease, sucrose and fibre content, length of internode, also the inheritance of the various substances injurious to manufacture, such as pectin, pentosan, protein and wax. It is clear that this work, devolving in the first instance on the geneticist cannot proceed very far without the assistance of biochemists, etc. By nurture we mean the effect of environment on the cane, and here we must be able to control this environment, especially in regard to soil and water supply by isolating the cane in tubs and silos. We need here the co-operation of plant physiologist, soil scientist, biochemist, micro-biologist and entomologist.

Again, the colloid chemist, biochemist, physicist and technologist must research and apply their own knowledge as well as that gained elsewhere by others, to the elucidation of the problems of manufacture—problems apparently simple, in reality more complicated since they deal with complex systems containing sugars, acids, colloids, mineral matter, all of which can vary individually.

The function of the chemical laboratory in England (using chemical in its broadest sense) would be partly to keep in touch with any research carried out elsewhere that had a bearing on the sugar industry. The preliminary study and application of this research could be carried out here. An important function of this laboratory, as already mentioned, would lie in the direction of refiners and refining problems, and also problems connected with the use of sugar and sugar products. We will not here concern ourselves with the beet sugar industry, though if this is developed in England, as seems possible, this laboratory would be enabled to study some of the manufacturing problems concerned.

The records office and intelligence bureau would serve as a central clearing house of information. Here would be indeed the results of any international research having any bearing on our industry. The amount of the world's research grows enormously every year, and it must be sorted out and made available in the proper direction.

HOW THE ASSOCIATION CAN BENEFIT THE INDUSTRY.

Let us first examine what existing stations have done—stations working principally on the improvement of the sugar content of the cane and its resistance to disease. Barbados furnishes a good example. Mr. BOVELL calculates that simply by replacing the White Transparent variety by three of his seedlings the planters have reaped a direct profit of over £4,000,000 within the last eight years. Similarly in Argentina it has been estimated that by the introduction of Java seedlings the planters of Tucuman are saving £500,000 per annum.

In Java the results have been even more striking. From 1886, when the first Experiment Station was founded, the average production has increased from 2·75 tons to 4·0–5·0 tons of sugar per acre, some varieties giving over 6 tons. The value of those new seedling canes have everywhere been admitted by direct financial returns, but the time has come to take a broader, more comprehensive view of the possibilities of sugar research.

As an example of what research can do in a somewhat unexplored field, let us take one or two cases affecting manufacture, and first the simple defecation of cane juice by lime and heat. Of the chemical and physical changes involved in defecation we have much to learn. For example, it was always thought immaterial whether the lime was added to the cold juice which was then brought to the boil, or whether the lime was added to the boiling juice. Some might say that the latter method of "liming hot" would invert part of the sucrose. This, however, is now generally recognized not to be the case, owing to the very slight acidity of the raw juice (when expressed in terms of hydrogen-ion concentration) and the short interval of time (2–3 minutes) during which the juice is heated. Now in the case of cold liming, the juice is boiled practically neutral, while by liming hot the juice is boiled while still acid.

In the first case less protein is coagulated than in the second case, for the albumin is coagulated much more completely from acid than from neutral solution; and, moreover, lime and lime salts inhibit the coagulation of the albumin. It is very desirable to remove as much of the protein as possible, for it is one of the principal colloids of the juice and is responsible with the other colloids for the viscosity of syrups and molasses, and is one of the factors preventing the crystallization of sugar.

While sugar chemists have never withheld their abuse of these colloidal substances, which they usually class as "gums," there has not been any systematic study made of them, except in Java, where investigations are now proceeding.

The Research Association has begun a preliminary research on the colloids of cane juice, which we find to consist, generally speaking, of pectin, pentosan (the principal constituent of cane gum), protein, tannin, cane wax, and possibly silica. The pectin is partly removed in alkaline clarification, but this does not remove the pentosan at all, which in the defecation process continues through manufacture till the final molasses.

In the carbonatation process, however, where a granular precipitate of calcium carbonate is formed in the juice, much of this pentosan is removed. We have already touched on the protein in connexion with "hot liming." The tannin of the cane is mainly responsible for the colour of cane products, since its iron salt makes an excellent ink. We know little about the removal of tannin except that, like all colloids, it can be adsorbed to a certain extent by activated carbons, and, in fact, solid surfaces generally. The importance of cane wax in clarification does not seem to have been sufficiently appreciated. When melted it forms an emulsion with the juice, and is found in appreciable quantity in the molasses.

There is no doubt that defecation, sulphitation, carbonatation, and activated carbon processes must all be examined from the colloid chemical aspect. Work on these lines cannot fail to be of lasting importance to the industry.

Is the sugar industry peculiar in that it can afford to neglect scientific progress? The object of scientific research in the sugar industry is not primarily financial profit, this accruing incidentally; it is to build up a strong and progressive industry.

HERBERT HOOVER, Secretary of the U.S. Department of Commerce, recently said:—"Industry and commerce have grown rapidly in recent years in their appreciation of the fundamental contribution of pure science of both chemistry and physics. The great increase in private research laboratories, the fine support of our public institutions, is the mark of this realization. Discovery and invention are now no longer the function of the garret genius. They are the result of deliberate organized exploration by our men of science. New discoveries and their application will come faster and more securely than ever before; and I believe the next half-century will be greater in its triumphs of science and in their contribution to human welfare than even the last 50 years—for we are better trained, better organized, better equipped for discovery than ever before."

In our description last month of the exhibit at Wembley of Messrs. WATSON, LAIDLAW & Co., Ltd., of Glasgow, we inadvertently referred to one of their centrifugal baskets as being fitted with a "Roberts-Gibson" discharger. As a matter of fact the mechanical discharger so exhibited is of that firm's own design and manufacture.

The output of beet sugar of the 1923 crop by the 110 State-operated sugar factories in Soviet Russia up to December 27th, totalled 20,244,000 poods of white granulated sugar and 477,000 poods of brown sugar, according to data compiled by the sugar trust. With the addition of the further estimated production of 10 of the sugar factories which have not yet completed operations, the ultimate total output of the State-operated factories and refineries is estimated at 21,200,000 to 21,300,000 poods, in terms of white granulated sugar, and with the output of the leased factories (about 1,000,000 poods more) gives a total estimated production of sugar for the year of about 359,700 long tons. (A pood equals 36 lbs.).[1]

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[1] Abstracted by *Commerce Reports* from *Economic Life*.

Notes on Brix, Solids, and Purity for the Use of Engineers.

By P. H. PARR.

Two of the most important of the various determinations which have regularly to be made for the routine work necessary for the efficient control of a sugar factory are those referring to the amounts of sucrose and of total solids present at different stages of the process of manufacture, from the cane to the final commercial sugar and the exhaust molasses. Unfortunately, the accurate determination of either of these two values is by no means a simple operation, but requires careful and experienced manipulation in the laboratory, not usually available except in very large centrals. In most factories, approximations to the true values, more readily obtained, are therefore employed; and these, with a comparatively few determinations of the true or absolute values, are sufficient in most actual cases.

For the sucrose, the usual determination is that of the polarization of the liquid, or of a solution of the sugar; the reading of the polarimeter is such that it gives directly the percentage by weight of sucrose present, supposing that the liquid under observation is a solution of sucrose in water at a definite temperature. With all working sugar juices, however, there are solids other than sucrose in solution, which usually have an effect on the rotation of plane polarized light, and (in cane products) in a direction opposite to that of sucrose. In general, therefore, the polarization of a solution of a cane product represents less than the true amount of sucrose present. For most of the routine work, the polarization value is sufficient, but for the technical control, regular determinations are made in the laboratory of the true or absolute amount of sucrose, using what is known as the double polarization method.

For the solids, the most common value and that most readily obtained depends on the density, or specific gravity, of the liquid, as determined by means of the Brix hydrometer. The Brix hydrometer reading gives directly the percentage by weight of sucrose present, again supposing that the liquid is a solution of sucrose in water at a particular temperature. The other solids always present in solution in actual sugar juices usually have an effect on the density greater than that of sucrose, so that, in general, the Brix of the liquids indicates more than the true solid content. The Brix hydrometer cannot readily be read with any great degree of accuracy, and in ordinary cases the values are only stated to the nearest tenth of a degree.

A second method of estimating the amount of solids present in solution depends on measuring the refractive index of the liquid. This method gives results nearer to the true values than does the Brix hydrometer, but the determinations are more troublesome to obtain, whilst the sample has always to be taken to the laboratory for examination. The chief value of the refractive value for the solids is that, with a micrometer or vernier scale on the instrument, readings can readily be made to the second place of decimals, which is of considerable importance in a large factory. As in the former cases, the refractometer values indicate the percentage by weight of sucrose in a pure solution; the other solids affect the value positively, so that, just the same as the Brix, the refractive solids are more than the true solids.

The third determination of the total solids in solution is the absolute value, found by evaporating a weighed sample to constant weight, and weighing the residue. This is a tedious process, and it is only in a very few factories that the absolute values of the solids are regularly determined.

The purity of sugar or sugar liquids being defined as sucrose ÷ solids, then, since there are two common methods of evaluating the first, and three methods of evaluating the second, there are six possible values for the purity, of which, of course, only one is the absolute value. Of the six, there are three of especial importance, which are in most common use, these being: First, the ratio Polarization ÷ Brix, generally known as the "apparent" purity; second, the ratio Sucrose ÷ Brix, known as the "gravity" purity; and, third, the ratio Sucrose ÷ Solids, which is the "true" or "absolute" purity. These terms are not universally accepted, so that in some instances "apparent" purity means Sucrose ÷ Brix, but they are most usual, and the foregoing definitions are to be understood with reference to the remainder of this article.

Since different factories use different ratios in making their returns, it is of considerable importance to have even approximate relations between them, so that when, for instance, a small factory returns an exhausted molasses as of 34° purity, a medium-sized factory returns one of 39, and a central returns one of 42, we are justified in believing that the first is the apparent purity, the second the gravity purity, and the third the absolute purity; and that, as a matter of fact, there is no particular difference betwixt them.

It is very useful to have rough relations between Brix and Solids, Polarization and Sucrose, and fair average values may be obtained.

Considering first the relation between the Brix, B, and the absolute solids, S, the most rational assumption is that the average effect on the specific gravity of the liquid, of the non-sugars in solution, is M times that of sucrose, so that—all values being taken decimally—the Brix of a solution containing S absolute solids of P absolute purity, or SP sucrose and $S(1 - P)$ non-sugars, will be:—

$$\begin{aligned} B &= SP + MS(1 - P) \\ &= S\{M - (M - 1)P\} \qquad (1) \end{aligned}$$

If we know a few corresponding values of B, S, and P, the value of M is given at once by:—

$$M = \frac{\dfrac{B}{S} - P}{1 - P} \qquad (1a)$$

M is of course variable, but a careful consideration of a number of analytical values of the variables shows that a fair average value for general purposes appears to be 1·12, giving:—

$$B = S(1{\cdot}12 - 0{\cdot}12\,P) \qquad (2)$$

This ratio between Brix and solids does not give anything like 90° Brix for a molasses of 80 solids and 45 purity, values which are often quoted as typical, but it *does* give results in fair agreement with many average values as determined by careful analysis. For example, the following table gives the actual (analytical) average values for the solids, purity, and Brix of a number of molasses; and also the Brix as estimated by the use of equation (2), corresponding to the actual solids and purity. Column A refers to the averages of ten analyses of Java molasses by Geerligs, quoted by Deerr[1]; column B refers to the average of ten Hawaiian molasses by Peck and Deerr[2]; and column C refers to the average of 23 Hawaiian molasses by Peck and Deerr[3]:—

		A.		B.		C.
Actual	Solids	79·6	..	82·9	..	83·1
	Purity	42·2	..	41·9	..	43·3
	Brix	85·1	..	88·0	..	87·6
Estimated Brix	.. ..	85·2	..	88·7	..	88·7

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[1] *Cane Sugar*, p. 445. [2] *Ibid.* [3] *Hawaii Expt. Stn. Bull.* 28.

and it will be seen that the agreement of the estimated values with the actual is quite good; the maximum difference is 1·1 points, and the average only 0·6 points. Of course, particular molasses will show much greater variations, but the present object is to obtain reasonable average values for general purposes.

The next question is as to the relation between the true sucrose content and the polarization, and the most rational assumption is that the average effect of the non-sugars in solution on the polarization is $-N$ times that of sucrose, so that the sucrose present, or SP, will give a polarization of SP, and the non-sugars present, equal to $S(1-P)$, will give a polarization of $-NS(1-P)$, the total effect being that the polarization, say P_1, will be :—

$$P_1 = S\{P - N(1-P)\} \qquad (3)$$

From this, the ratio of the polarization to the true sucrose will be :—

$$\frac{P_1}{PS} = 1 + N - \frac{N}{P} \qquad (3a)$$

and if we know the values of the polarization, etc., for a given molasses, we can calculate N from :—

$$N = \frac{P - \frac{P_1}{S}}{1 - P} \qquad (3b)$$

A reasonable value for N appears to be 0·1, giving :—

$$\frac{P_1}{PS} = 1{\cdot}1 - \frac{0{\cdot}1}{P} \qquad (4)$$

Considering the three sets of average molasses as before, we find :—

	A.	B.	C.
Actual polarization	29·2 ..	30·5 ..	31·2
Estimated „	29·0 ..	29·9 ..	31·2
Actual apparent purity	34·3 ..	34·7 ..	35·6
Estimated „ „	34·0 ..	33·7 ..	35·2
Actual gravity purity..	38·2 ..	39·4 ..	41·1
Estimated „ „	39·5 ..	39·2 ..	40·5

and the agreement, which on an average is only 0·5 in error, with a maximum of 1·3, is again quite satisfactory for general purposes.

The above relations, chiefly, though not by any means wholly, derived from a consideration of exhaust molasses, will actually vary with the concentration as well as with the exact composition, but, in the absence of more particular information, they may be assumed, to a first approximation, to hold generally; they form the basis for the following table, which will be found to be of considerable value for engineers for general comparative and estimating purposes. In view of the foregoing remarks, the headings of the columns are self-explanatory.

Referring to the refractive values for the solids, these are usually almost exact means between the Brix and the absolute values. Considering the figures quoted by DEERR,[4] the first table gives an average refractive value for the solids of 28·73, whilst the mean between Brix and absolute solids is 28·75; the second table gives refractive 30·56 and mean 30·34; whilst the third table gives refractive 26·15 and mean 26·32, the difference being negligible for general average purposes.

In conclusion, the writer would emphasize the fact that the foregoing ratios are only rough approximate practical averages, as deduced from a study of very many analyses, and that they are without any real technical significance; at the same time, the formulæ are rational in construction, and, in the absence of definite information, the figures given are of considerable value for general comparative purposes in the hands of engineers.

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[4] *Cane Sugar*, pp. 491-2.

Notes on Brix, Solids and Purity for the Use of Engineers.

TABLE OF BRIX, SOLIDS, AND PURITY RELATIONS.

Absolute Purity. $P.$	Brix. / Solids. $B/S.$	Polarization. / Sucrose. $P_1/PS.$	Gravity Purity. $P'.$	Apparent Purity. $P''.$
1·00	1·000	1·000	1·000	1·000
0·99	1·001	0·999	0·989	0·988
0·98	1·002	0·998	0·978	0·975
0·97	1·004	0·997	0·966	0·963
0·96	1·005	0·996	0·955	0·951
0·95	1·006	0·995	0·944	0·939
0·94	1·007	0·994	0·933	0·927
0·93	1·008	0·992	0·922	0·915
0·92	1·010	0·991	0·911	0·903
0·91	1·011	0·990	0·900	0·891
0·90	1·012	0·989	0·889	0·879
0·89	1·013	0·988	0·878	0·867
0·88	1·014	0·986	0·867	0·855
0·87	1·016	0·985	0·856	0·844
0·86	1·017	0·984	0·846	0·832
0·85	1·018	0·982	0·835	0·820
0·84	1·019	0·981	0·824	0·809
0·83	1·020	0·980	0·813	0·797
0·82	1·022	0·978	0·802	0·785
0·81	1·023	0·977	0·792	0·774
0·80	1·024	0·975	0·781	0·762
0·79	1·025	0·973	0·770	0·750
0·78	1·026	0·972	0·760	0·739
0·77	1·028	0·970	0·749	0·727
0·76	1·029	0·968	0·739	0·716
0·75	1·030	0·967	0·728	0·704
0·74	1·031	0·965	0·718	0·693
0·73	1·032	0·963	0·707	0·681
0·72	1·034	0·961	0·697	0·670
0·71	1·035	0·959	0·686	0·658
0·70	1·036	0·957	0·676	0·647
0·69	1·037	0·955	0·666	0·636
0·68	1·038	0·953	0·655	0·624
0·67	1·040	0·951	0·645	0·613
0·66	1·041	0·948	0·635	0·602
0·65	1·042	0·946	0·624	0·590
0·64	1·043	0·944	0·614	0·579
0·63	1·044	0·941	0·604	0·568
0·62	1·046	0·939	0·593	0·556
0·61	1·047	0·936	0·583	0·545
0·60	1·048	0·933	0·573	0·534
0·59	1·049	0·931	0·563	0·523
0·58	1·050	0·928	0·553	0·512
0·57	1·052	0·925	0·542	0·501
0·56	1·053	0·921	0·532	0·490
0·55	1·054	0·918	0·522	0·479
0·54	1·055	0·915	0·512	0·468
0·53	1·056	0·911	0·502	0·457
0·52	1·058	0·908	0·492	0·446
0·51	1·059	0·904	0·482	0·435
0·50	1·060	0·900	0·472	0·424
0·49	1·061	0·896	0·462	0·413
0·48	1·062	0·892	0·452	0·402
0·47	1·064	0·887	0·442	0·392
0·46	1·065	0·883	0·432	0·381
0·45	1·066	0·878	0·422	0·370
0·44	1·067	0·873	0·412	0·359
0·43	1·068	0·867	0·402	0·349
0·42	1·070	0·862	0·393	0·338
0·41	1·071	0·856	0·383	0·328
0·40	1·072	0·850	0·373	0·317
0·39	1·073	0·844	0·363	0·306
0·38	1·074	0·837	0·354	0·296
0·37	1·076	0·830	0·344	0·285
0·36	1·077	0·822	0·334	0·275
0·35	1·078	0·814	0·325	0·264
0·34	1·079	0·806	0·315	0·254
0·33	1·080	0·797	0·305	0·243
0·32	1·082	0·787	0·295	0·233
0·31	1·083	0·777	0·285	0·222
0·30	1·084	0·767	0·276	0·212

With a view to helping to eliminate the inferior leather belting which is often met with on the British market, the Federation of Leather Belting Manufacturers of the United Kingdom has now compiled a standard specification which, they say, is to be regarded "as the minimum standard of quality that should be demanded by buyers and users who require a belt of reliable quality."

Cost figures for 1922 for two Philippine mills were given in a report of a special committee of the Philippine Sugar Association, as follows[1] :—Manufacturing cost, 0·92 cents per lb. for one and 0·82 for the other, as compared with 0·69 for Cuba and 1·12 in Hawaii. Cost of cane, 0·92 and 1·07, as against 1·38 for Cuba and 1·71 for Hawaii. Transport to the U.S.A., 0·71 and 0·66, as compared with 0·22 for Cuba and 0·48 for Hawaii. Total cost of production (not including interest), 3·06 and 3·20, as compared with 2·49 for Cuba and 3·93 cents per lb. for Hawaii. These figures are hardly representative of the Philippine average, the data being taken from two of the largest and most efficient mills there. An average figure would be perhaps 20 per cent. higher, that is considerably higher than the Cuban average, and only slightly lower than the Hawaiian.

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[1] *Sugar News*, 1924, 5, No. 4, 208.

Washington (Spring) Meeting of the Sugar Section of the American Chemical Society.

The spring meeting of the American Chemical Society was held this year at Washington, D.C., and several interesting papers were read and discussed before the Division of Sugar Chemistry. Short abstracts of these are given below.

Super-defecation of cane juice. W. D. Horne.—A process has been devised to secure the advantages of complete precipitation of all the impurities that lime will throw down, without suffering the disadvantages of working up a highly alkaline juice.[1] This is accomplished by liming to a point between alkalinity to litmus and alkalinity to phenolphthalein, heating, settling and decanting. The decanted juice is then treated with a specially prepared phosphatic reagent, which precipitates the lime and other bases, after which the solution is slightly reheated and settled. The juice, thus raised more than usual in purity and lighter and cleaner, yields more abundant and more readily worked sugars. The phosphatic precipitate is used as cane fertilizer, conserving its cost.

Cane colouring matters and juice reactions when liming. J. F. Brewster. This paper describes experiments with pigments isolated from cane in the attempt to discover which of them are responsible for the yellowing of juice in ordinary defecation practice. Chlorophyll, carotin and xanthophyll appear to have no effect. They are insoluble in the mill juice and not changed by lime-water even when present as colloids. Saccharetin can be present only as colloid in connexion with fibre, and exhibits a change to yellow only at fairly high concentrations of alkali. Unpublished data of BREWSTER and DODDS show that reducing sugars cause no darkening until juice is severely overlimed. The responsibility for the yellowing of juice on liming is placed upon the soluble pigments which react after the nature of dilute indicators.

Filtration of limed versus limed and sulphured cane liquors. C. F. Edmunds and A. S. Elsenbast.—The clarified juices and syrups resulting from raw cane juice defecated with lime and sulphur are easier to filter than juices treated with lime alone. Filter-press areas and quantities of "Filter-Cel" necessary for the filtration of the various juices and syrups in plantatation white sugar manufacture are given from the factory records. The total filter-press area required to filter limed and sulphured clarified juices and syrups is 3·4 sq. ft. of filter area per ton of cane ground per 24 hours on a Sweetland Filter, with a total "Filter-cel" consumption of 1·6 to 2·0 kgs. per ton of cane.

Inversion losses in cane sugar manufacture. C. F. Walton, Jr., M. C. McCalip and H. F. Hornberger.—This paper reports results of an investigation undertaken primarily for the purpose of reducing the study of inversion to an analytical basis, i.e., to ascertain what experimental procedure and what analytical methods are most suitable for the purpose. Experiments have subsequently been conducted using improved analytical methods and procedures duplicating actual factory conditions. In sugar-houses where plantation granulated is manufactured by the sulphitation process, little if any inversion probably occurs when the juice is limed back to a hydrogen-ion concentration of 6·9 (that is, a titrated acidity of 0·60 c.c. N/10 sodium hydroxide), and approved conditions of time and temperature are maintained. It is indicated that slightly higher acidities can be carried safely, although this point has not yet been exactly determined. By liming only, as in raw sugar manufacture, the acidities should be somewhat lower, especially if high temperatures are to be maintained for any extended period of time.

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[1] U.S. Patent, 1,486,091.

Surface tension (colloid content) of sugar products. *K. R. Lindfors.*—Colloidal substances are of great importance in sugar-house work as they influence boiling, crystallization, and the colour of the sugar to a considerable extent. As colloids have a strong depressing influence upon the surface tension, the determination of the latter furnishes a means of estimation. With the apparatus designed by Dr. DU MOÜY the surface tension can be found in half a minute. Mineral salts have very little effect upon the surface tension, hence it bears no relation to the purity of the juices. Colloidal silica, gums, and organic acids, on the other hand, depress the surface tension to quite an extent, even in very dilute solutions. Hence surface tension immediately shows any irregularities in the sugar-house work, especially improper carbonatation, insufficient heating, poor filtration and inferior quality of the sugar. Adsorption of colloids to the surface of sugar particles interferes with the rapid growth of the crystals. As the adsorption is practically inversely proportional to the surface tension, the latter gives us direct information as to the presence of such interfering substances; and, by proper control of the beet end, allows the elimination of a large part of the disturbing colloids. Surface tension further indicates the keeping quality of granulated sugar; the adsorbing power of charcoal and carbons; the comparative refining values of similar raw sugars; and, finally, differentiates between beet, refinery, and plantation white granulated sugar.

Adsorption effects of filtering materials on sugar solutions and their influence upon sugar analysis. *G. H. Hardin and F. W. Zerban.*—One more source of error in the polarization of raw sugars, in addition to the twelve definitely recognized, has been found in the effect of filter paper on the concentrations of sugar solutions. Ordinary filter-paper, when perfectly dry, in intimate contact with 100 c.c. of a normal cane sugar solution, takes up enough water to raise the polarization about 0·07°V. per grm. of paper. Paper with high moisture content, on the other hand, tends to dilute the sugar solution, and there is a definite moisture content of filter-paper at which an equilibrium condition with the sugar solution obtains. Proportional polarization changes are observed with more dilute sugar solutions. Filter-paper of different makes show no measurable differences in effect. The adsorption equilibrium is established very quickly. Absorbent cotton has the same effect as an equal weight of filter-paper, but asbestos and "Filter-Cel" (kieselguhr) do not measurably affect the concentrations of sugar solutions. In practical raw sugar analysis it is not sufficient to reject only the first few drops of the filtrate, as practised by many analysts, but at least 25 c.c. should be discarded to obtain the closest possible approximation to the correct polarization.

Study of hydrogen-ion concentration in beet products. *H. S. Paine, B. C. Sibley and J. C. Keane.*—A systematic survey of pH values for diffusion juice, first and second carbonatation juice, and third saturation juice, employing the electrometric method, was made in an Idaho beet sugar factory during the entire campaign and in a Nebraska factory during the last month of the campaign. These data were compared with alkalinity values determined for the same sample and expressed in terms of calcium oxide. The average pH values for first and second carbonatation juices and third saturation juice were, respectively, 11·17, 9·92, and 9·19 in the Idaho factory, and 10·33, 9·05, and 8·36 in the Nebraska factory. The average pH values for the three juices were systematically higher in the Idaho factory for a given average alkalinity value during the second half than during the first half of the campaign, and in both instances were higher for definite alkalinities than the average pH values for the three juices in the Nebraska factory. This would indicate, for a given amount of total base or acid, a difference in predominence of stronger bases or weaker acids, or in buffer effect. The constructive value of pH determinations is more likely to be found in connexion with the operations of second carbonatation and third saturation than in first carbonatation. pH data, in combination with alkalinity values and ash analyses, may be of value for studying acid-base equilibria under certain conditions.

A simple turbidiscope. W. D. Horne and E. W. Rice.—A novel form of apparatus is described for detecting faint degrees of turbidity in solutions. The arrangement consists of an electric light bulb contained in a metal cylinder, through a horizontal slit in which the light shines downward angularly across test tubes containing the samples, so that the turbidity-forming particles reflect the light upward to the observer, who views them against the black background of the painted metal cylinder.

United States patents on boneblack and decolorizing carbons. W. D. Horne A subjective index of the United States patents dealing with boneblack and decolorizing carbons is presented, in which these patents are grouped under 22 different heads. Under each heading are given, in numerical order, the official number of the patents falling under that subdivision, varying from one to 45 in the different lists. By means of this index one can know instantly what patents cover any particular phase of the subject.

The determination of sucrose and raffinose in beet products by the enzyme method. R. T. Balch—The enzyme method here described for the determination of sucrose and raffinose utilizes purified and concentrated top and bottom yeast extracts, containing invertase and invertase *plus* melibiase, respectively. The ordinary method of clarifying the sugar solution with basic lead acetate solution is recommended, but de-leading is accomplished with ammonium dihydrogen phosphate, which is an ideal de-leading agent, inasmuch as it completely removes the lead from solution, contains no water of crystallization, and leaves the solution of proper acidity for enzyme activity. Hydrolysis is usually made over night by the 50-55 c.c. or 50-100 c.c. method of inversion, but may be accomplished in 30-40 mins. using 10 c.c. of the enzymes instead of 5 c.c. ordinarily taken, and by heating to 50-55°C. The inversion constant varies with the concentration, which Browne has shown to be equal to 132·0 for 13 grms. sucrose per 100 c.c. Certain errors are discussed when the method is applied to impure factory products. The method has been successfully applied to factory control in a study of sugar extraction and losses in beet sugar-houses.

Specifications of lime for use in the manufacture of sugar. M. J. Proffitt.—The author recommends the following tentative standards of composition calculated to the non-volatile basis :—

	Sugar-Soluble Lime, per cent.		Loss on Ignition, per cent.
Limestone (after calcining)	90	....	4
Quicklime, not specified for preparing lime powder	85	....	5
Quicklime, specified for preparing lime powder: If			
sampled at place of manufacture	90	....	2
If sampled at other than place of manufacture ..	90	....	5
Lime powder	90	....	2
Hydrated lime	85	....	40 (maximum)

Bonus and penalty provisions are recommended for variation from these standards. Magnesium oxide and the common chemical impurities are regarded as diluents.

Countercurrent gas washer. M. J. Proffitt.—The apparatus consists essentially of (1) a liquid reservoir, (2) an air lift for the circulation of the liquid, (3) a gas-and-liquid separator with liquid seal, (4) a bead-packed tower scrubber, (5) gas-vent and drain cocks for convenience in filling and operating. The operation is entirely automatic, the motive power being supplied by the gas-pressure (70 to 200 grms. per sq. cm. or 1 to 3 lbs. per sq. in. in the sizes actually constructed). The flow of the gas is as follows: (1) through the vertical air lift with turbulent contact with washing liquid, (2) separation from liquid and return to bottom of tower, (3) upward flow through tower in contact with a large surface of liquid counter-flow.

Fractional leaching of Steffen's waste-water ash. Julius Greenwald.—Ash consisting of potassium carbonate, 30·15 per cent.; sodium carbonate, 20·62 per cent.; potassium chloride, 25·50 per cent.; and potassium sulphate, 10·32 per cent. was subjected to a process of continuous leaching in a battery of percolators for the purpose of obtaining a relatively higher concentration of potassium carbonate solution with less evaporation than is required in the fractional crystallization processes. Several methods were tried out. The best results were obtained by using screened ash of 40-mesh. When the system reached equilibrium, the end liquor produced was of 52° Bé. concentration with the following average composition: K_2CO_3, 80·70 per cent.; Na_2CO_3, 15·21 per cent.; KCl, 2·56 per cent.; and K_2SO_4, 1·01 per cent. The soluble portion of the solid residue contained 13·86 per cent. K_2CO_3, 15·34 per cent. Na_2CO_3, 37·5 per cent. KCl, and 34·05 per cent. K_2SO_4. The recovery of K_2CO_3 in the end liquor averaged 78·74 per cent. of the K_2CO_3 charged.

Effect of some inorganic salts on the polarization of sugar solutions. R. J. Brown. Starting with the results of Jackson and Gillis, which show the effect of a salt on the polarization of a sugar solution of normal concentration to be proportional to the amount of salt present, it is attempted to show that the effect of a salt is also proportional to the amount of sugar present. This is shown to be true, within the limits of analytical error. Averages of a large number of results were necessary, because of rather large variations in individual determinations. Actual sugar present is calculated by a formula as follows: $S = P + KPM$. This formula is the same as that of Jackson and Gillis, except that their value for K is divided by 100 and the polarization or per cent. of sugar is introduced. The possibility of disregarding the effect of inorganic impurities on true sugar analysis of thin juices by use of enzyme inversion is mentioned. This requires that the effect of a salt on the invert polarization is approximately twice its effect on sucrose. Such is indicated by the results of Jackson and Gillis.

Further study of ash in sugars. Y. L. Pun and J. R. Withrow.—The present paper is a continuation of the previous study on the methods of ash determination read before the last spring meeting in New Haven.[1] It is now shown that: (1) When iron is present in the sample, the sulphate method does not yield constant results as it is customarily supposed to do, the variation due to the decomposition of iron sulphate being clearly proved; (2) A definite relation between the sulphate ash and the direct ash can be obtained from the methods employed at 500° C.

Production and uses of maltose fondant. By *H. C. Gore.*—The method of converting starch into snow white masses of crystalline maltose reported at the September 1923 meeting of the Sugar Division of the American Chemical Society, has been further simplified and improved. In liquefying, the mash is heated at a temperature gradually increasing from 70° to 80°C. from four to five hours, then boiled for the purpose of completing the dispersion of starch, cooled, and the liquefaction completed by further digestion with additional malt at from 65° to 70°. The complete liquefaction thus obtained facilitates filtration at a later stage of the process.

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[1] *I.S.J..* 1923, 252.

Recent Work in Cane Agriculture.

HAWAIIAN CANE SEEDLINGS. *J. S. B. Pratt, Jr. Report of the Committee in charge of the Experiment Station, Hawaiian Sugar Planters' Association, for the year ending September 30th, 1923.*

Mr. PRATT appears to have joined the staff as Associate Agriculturist in December, 1922, and is devoting his whole time to the extension work on seedlings. He considers that this line is to be regarded as the big project of the year in the sugar work of the islands.

During the year under report 80,254 seedlings were set out in the fields for trial, being double the number in any previous year. These were distributed as follows:—Manoa district 40,000, Kohala district 23,000, Oahu Sugar Company 10,000, Honolulu Plantation Company 4054, Makiki 3000 and Waipio 200. A list is given of the 190,605 seedlings raised, year by year, since 1904 under the auspices of the Experiment Station, and varying from 25 in 1912 to 42,042 in 1920 and over 80,000 in the current year. Assuming that 4000 seedlings are planted to the acre there will thus be 20 acres of new seedlings in the present year.

The author summarizes the most promising seedlings thus far produced in Hawaii, both for *mukai* (lowland) and *mauka* (upland) conditions, as follows:—

Most promising seedlings for Makai lands. It is very striking how many of the desirable seedlings have been obtained from Lahaina, H 109 and Striped Mexican as parents (the male parentage appears to be usually judged by the evidences of the characters of the seedlings).

(*a*) Early propagations. None of value excepting H 109.

(*b*) "H 400" series. H 456 is regarded as the most promising, as taking the place of Yellow Caledonia in the Hilo district. H 468, 471 and 472 are also being carried on.

(*c*) The 1915 series—H 109 lot. H 5922 and 5965 are at present the best and are mostly grown at Waialua.

(*d*) 1917 series—Oahu propagation. No. 229 now called Honokaa No. 1 (Striped Mexican seedling), No. 347 now called Ewa 800 (Lahaina), and No. 394 now called Ewa 801 (H 109) are of exceptional promise.

(*e*) The 1917 series—Maui or Wailuku. Perhaps Wailuku Nos. 2, 4, 6, 9, 10, 13 and 50 are more in favour on the plantations, 17 of which are growing these canes.

(*f*) The 1918 seedlings—H 109. About 15 of these are considered as worth carrying on (the Nos. all commencing with H 89 . ., and sometimes called the "89 series"). In two tests at Makiki H 8994, H 89102 and H 8988 had better juice than H 109 under the same conditions.

(*g*) The Ewa seedlings. Of these Ewa 177, 720 and 509 are perhaps the best; but, now that two seedlings of the 1917 series—Oahu have been transferred to this series, Ewa 800 and 801 are most desirable.

Seedlings for Mauka lands. For Mauka lands D 1135 crossed with Tip canes would seem to be most desirable, with Uba and Badila as a second choice.

(*a*) Kohala seedlings. In 1917 out of a batch of 277 D 1135 seedlings, five namely K 73, 107, 115, 117 and 202, are at present excellent ratooners as 3rd ratoons and are promising commercial canes for the district. All of them appear to have Tip characters, suggesting this class of cane as male parent. This supposed cross, D 1135 by Tip, will be prosecuted extensively.

(*b*) Manoa seedlings. About 2000 Tip crosses were sent out this year. In 1922 some 200 were sent out to four estates without further selection, and will be carefully watched.

(*c*) Uba seedlings. Five seedlings were raised from Uba after pollination by D 1135 and these are assumed to be the result of this cross. Of these five, Uba No. 1 is a big stooler and fast grower: it shows many desirable Uba characters with a cane as thick as D 1135,[1] and is the kind of cane desirable for mauka land, although it has not been as yet tested. If tassels are obtained this cane will be used as one parent.

(*d*) Badila seedlings. Only a few exist at present but crosses with D 1135 and Tip canes are desirable. The chief difficulty is to get Badila to arrow at the same time as other varieties in Hawaii.

The author has set himself the task of keeping detailed records of the seedlings sent out to the various plantations, and has for this purpose installed a "Kardex" system of filing, with one colour for seedlings on the plantations and another for seedlings to be sent out as soon as possible. The 1918 series—H 109 was sent out to nearly all plantations during the year and this distribution will be completed by next harvest. Wailuku seedlings are fairly widely dispersed and these will be in the hands of all planters next year, and this also applies to the Ewa seedlings in hand. Kohala seedlings will at the same time be established on all mauka plantations requiring this type of cane. The Manoa Tip seedlings were cut and sent to four plantations, two in Hawaii and two in Kauai.

The last page of the report deals with the class of work proposed in the immediate future. At present the seedlings in cultivation and being tested will be followed up. If any particular seedling shows special promise it will be multiplied in anticipation of a demand arising for it, thus saving much time. The work of raising seedlings is being concentrated at Makiki, for here it is possible to deal with large numbers cheaply. "A rigid selection" will be made when the seedlings are placed in the field, so that only 15–20 per cent. of those raised will be sent out to plantations for further trial. As indicating the soundness of this policy the author gives the result of an experiment in which on putting the seedlings in the field the strong ones were separated from the weak, and both lots were grown on; in the resulting harvest hardly one of the weaklings was worth going on with. A quotation from the *Record* points out that from many thousands of seedlings only a few have survived in Queensland; only four out of over one million raised in Barbados have gone into general use; and possibly seven out of 200,000 have been useful in Demerara. Hawaii was therefore very lucky in obtaining H 109 out of a batch of 5000, and it is surmised that several seedlings exist which are at any rate equal to that fine cane. In 1917, after rigidly roguing the seedlings put out, the ones grown on were divided each into four parts, and these were grown on in as many separate sets of conditions. Already Honokaa has 14 acres of one of these, which was very poor at Pioneer but better at Oahu: if tested in the Makiki conditions it is not likely that this seedling would have survived.

THE SUGAR CANE PROJECT OF THE BUREAU OF AGRICULTURE (PHILIPPINES). ASUNCION AND MEDINA. *Philippine Agricultural Review, Vol. XVI, No. 1, 1923.*

This paper consists of a summary of the work of the Bureau of Agriculture on sugar cane, from its commencement in 1903 to the present date. The first action taken was the introduction of new cane varieties, and in 1905 five were obtained from Hawaii, namely: White Bamboo, D 74, Singapore Striped,

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[1] It appears to be assumed that Uba pollen is completely sterile, but no tests are mentioned as to this. In case of occasional fertile anthers a small number of selfed seedlings would be produced and these of course would vary considerably in thickness.—C. A. B.

Tiboo Mirid and Louisiana Purple. Subsequently many other varieties were introduced, to the number of 80 altogether; these were grown and compared with the native varieties, and retained or discarded according to their relative behaviour. Four experimental stations were interested in sugar cane work, La Carlota at first and afterwards Alabang and Singalong, with the co-operation of Lamao. Seed was distributed of those canes considered most suitable, over a million cuttings having been sent out between 1915 and 1921.

The Bureau founded demonstration farms and plots, issued instructions as to cultivation and sugar manufacture, analysed samples and gave general advice, and lately has entered into close co-operation with the Sugar Central Board. A manual on cane growing and the making of sugar was written by Hines, then technologist, and printed in English and Spanish, besides which numerous articles have appeared in the local Agricultural Review and foreign sugar journals. Of the experimental work, the most useful lines have been the variety tests, milling tests, soil investigations and survey, analyses of different varieties, hybridizing and growing the seedling canes. The variety tests were at first only concerned with the growth and adaptability of the more promising kinds, as regards vigour, size, stooling and resistance to disease; but in 1913 analyses were added, including weight of stalks, tonnage per hectare, per cent. extraction, content of sucrose, fibre and other compounds in the cane, the amount of sucrose, glucose and non-sugars in the juice and its purity. Tables are given of the results of such analyses during 1913 to 1915, and for the five-year period 1916-20 at Carlota Experiment Station. As a general rule the native varieties gave a high percentage of sucrose and good purity, whereas the imported canes gave large yields but were low in purity and sucrose; and it is remarked that a blending of these characters would give the ideal cane for the islands.

As the result of several years' study, the following foreign varieties were judged to be the best: H 109, 309, 16, 20 and 228, Louisiana Striped, Yellow Caledonia, Badila, Formosa, J 247 and Cheribon. Among the native canes the best were Negros Purple, Mindoro, Inalmon, Luzon Nos. 1, 2, 3 and 4, and Cebu Purple. Seedlings from H 16, 17, 109, Inalmon and Badila were obtained in December, 1920, and were planted out in April, 1921. The analysis of the juice of seedlings during 1910 and 1921 is given on a Table, in which we note that the sucrose varies from 13 to 18 per cent. and the glucose from 1·99 to 0·75 per cent.

Manurial experiments were commenced in 1905 with the application of 400 kg. guano per hectare, but without any resulting improvement. In 1920 work was started with Negros Purple and plots were manured with bagasse ash, farm yard manure, unburnt lime, filter-press cake, copra meal and bat guano, and the results are recorded in a Table. All of the manured plots showed a gain as compared with the check plots, excepting filter-press cake; and with bagasse ash, burnt lime, copra meal and farm yard manure there was a gain after deducting the cost of the manure. In 1921 an experiment was made with a mixed fertilizer which was given at the rate of 500 kg. per hectare, the analysis of which is as follows:—moisture 12·32 per cent., nitrogen 3·35, phosphorus anhydride 11·23, potash 4·43. Tillering at the end of November was in favour of the manured plots, the figures being 4·5 per stool as against 3·9 for the unmanured plots; the manured plots arrowed earlier than the unmanured. In the Table giving the results of this experiment the manured plots gave over four tons of cane per hectare more than the unmanured, while the sugar obtained was 11 piculs more in the manured plots. As to pests and diseases of the cane observations were commenced in 1905 but only of a general nature; but in 1920 Medalla made a complete study of the relative liability of the different varieties grown, and found that Mosaic was prevalent. The present work of the Bureau is being carried on along the usual lines, with active co-operation of the College of Agriculture, Sugar Centrals Agency and the various planters and factories.

SOME STUDIES IN CONNEXION WITH THE DEVELOPMENT OF THE SUGAR CANE. *H. A. Tempany. Department of Agriculture in Mauritius, Bull. 9, Scientific Series. 1924.*

This paper records various observations on the above-named subject and is illustrated (16 pp., four plates and one chart). Referring to previous work on the physiology and growth of the sugar cane, that chiefly carried out in Java, Louisiana, Guadeloupe and Mauritius deals only with the aerial part of the cane plant, while AUCHINLECK in 1909 and recently BARBER have elucidated the macroscopic structure of the underground parts, and the last-named has indicated the very varying degrees of complexity in the case of different varieties. As a knowledge of this part of the cane is essential to the proper understanding of what follows, a brief account of the underground system of the sugar cane is first given, mainly summarized from the papers by the latter author.

With regard to the development of a stool from a cane cutting, this was studied in three cane varieties, White Transparent, M.P. 55 and D.K. 74, planted in September, 1920. The results are recorded in tabular form, as to the average and maximum root length, the average and maximum shoot length to the tip of the leaves, and the shoot length to the growing point; the measurements were taken on seven occasions, from one to nine weeks after planting. The development of fibrous roots (from the cutting only?) appears to continue steadily until the fourth or fifth week, when this development stops and these roots gradually die. It is remarkable how very early branching commences in the main shoot, this occurring in the fourth and fifth week, simultaneously with the protrusion of feeding roots (from the young shoot?). In the case of a cane examined eight weeks after planting, a single eye had developed into a shoot with three well marked secondary branches, and a further eye had commenced to sprout. Only certain eyes grow out in the early stages. The young plant appears to remain entirely dependent on the cutting for its nutriment until the fifth week, and the cutting remains perfectly preserved till the twelfth week after planting, when disintegration commences, so that in 20 weeks, although the cutting still persists, it contains nothing but a mass of decaying pith. The feeding roots start developing at a much earlier stage on the branches than on the main stem. These observations apply only to cuttings which have been duly supplied with moisture. In dry conditions the cuttings may remain in the soil without modification, beyond the protrusion of a certain number of fibrous roots, and continue to be perfectly viable for a period of six weeks after planting. Plate 1 of the Pamphlet illustrates these observations.

The author then proceeds to discuss changes taking place in the internal anatomy of the cutting during the development of the young plant. He commences with certain remarks on the structure of the cane stem and illustrated the changes by rough drawings on Plates 2 to 4. It order to determine from which internode a bud obtains its nutriment, he made cuttings immediately above and below a bud and planted them; as a result he considers that the bud can live on any part of the cutting which is available, whether above or below the leaf scar. In another experiment the author divided a number of canes, belonging to three varieties, into three parts, upper, middle and lower. Of these he analysed the juice of the upper and lower and assumed that the average of their analyses would approximate to that of the middle portion, which, however, he planted. With this as a basis he dug up certain of the plants at intervals and analysed them to see what changes were taking place in the character of the juice as the buds swelled and put forth shoots. As a result he found a steady diminution of sucrose in the cane, while the glucose remained low excepting in one or two cases where saprophytic organisms had attacked the planted pieces. In eight periods at which analyses were made, from 7 to 100 days after planting, the sucrose regularly declined from 97·2 per cent. to 45·8 per cent., and the curve of decrease plotted out was approximately a straight line (Fig. 15). It was concluded that in the conditions at Reduit, where the experiments were carried out, the sucrose in the parent stem is laid under contribution by the developing shoots for at least 100 days after planting, and that half of this substance is used up during that time for metabolism and growth.

A further section of the paper deals with the function of stored sugar in the cane, but we have not space to follow out the details, which deserve careful perusal. The author surmises among other things that storage of sugar is an original characteristic of the sugar cane, primarily for the purpose of providing for seed formation; and that the current idea that this storing capacity has been increased by artificial selection should be somewhat revised, in view, among other facts, of the discovery of the excellent varieties of cane in New Guinea, where there could be no question of agricultural selection.

REPORT OF COMMITTEE ON IRRIGATION. *J. S. B. Pratt, Jr.* (*Chairman*). *Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1923.*

Overhead irrigation.—The greatest development in irrigation during the year has been in the introduction of this method, by which the water is distributed over the canes as in rain. The method is not new in the islands, the Skinner system having been used for some time in irrigating alfalfa and garden crops. In 1915-16 it was applied to sugar cane by A. W. COLLINS on a two-acre plot, but the Maui Agricultural Company found that the cost was exorbitant, the wind caused unequal distribution of the water and the tonnage of canes decreased. On the other hand the amount of water used was much less. The essential feature of the Skinner system is that the water is carried by horizontal pipes, which obviously get very much in the way, with small nozzle openings about every two feet.

About six years ago B. D. BALDWIN at Makaweli laid out a few acres under another overhead system, the principle being vertical standpipes some 25 ft. high and 80 ft. apart, though later 60 ft. was considered a better distance. After much experimenting, the nozzles chosen were of the geared type, costing $14 each, an expensive item even at only eight to the acre. Lastly, at Hawi, JOHN HIND has tried overhead irrigation for several years and in the year under report the experimental stage has been passed; 100 acres are already thus treated and 88 waiting for the pipes to arrive, while in the next year 250 more acres will be added. The system appears to be excellently adapted to the Hawi conditions.

The author illustrates the system by a hypothetical even field with a gentle slope (one must go back up a slope to get the necessary head of water, unless, as in the new field at Hawi, compression pumps are erected, giving, say 40 lbs. to the sq. in.). From the main pipe, which may be 6 in. in diam., laterals are given off right and left every 56 ft., this distance including 14 rows 4 ft. apart. The laterals should not be more than 400 ft. long, and should come off at right angles, the water thus having to travel the shortest distance. On the laterals standpipes are erected every 60 ft., this meaning three 20 ft. lengths of pipe without cutting. The height of the standpipes must be chosen according to the locality. The diameter of the main pipe is reduced as pressure increases; so also the laterals which may commence at 1½ in. and be gradually decreased to 1¼, 1, ¾ in., and the standpipes from ¾ to ⅝ in.; but all these figures will want revision not only as to local circumstances but also according to the amount of water to be delivered in a given time. The sprinklers are made in the estate shop at Hawi at a cost of under half a dollar each. They consist of two parts, so arranged that, when the canes are high, the top may be disconnected by a stick and the system blown free of clogging. All the water is screened before entering the main pipe. The details which will vary from field to field can be worked out in the office from contour maps.

The advantages claimed for this overhead system of irrigation are as follows:—Easy regulation of the amount of water given; water saving, although no conclusive data are yet available; loss by seepage from channels done away with; cheap cultivation as in unirrigated conditions, and very little hand-hoeing; after irrigation, cultivation gives a mulch besides weeding; watering can commence immediately after harvest (the absence of this being responsible for the loss of certain valuable kinds like H 109); labour saving in cultivation and irrigation (in one case given, 14 men doing the work of 120 on the old system). Protection against fire is obvious; the harvesting is simplified because of straight rows of canes; no dirty ditches, and less weeding because of animal cultivation; the area used up by ditches is saved for planting; watering can go on by night as well as by day; and the action of manures is not delayed by the lack of moisture. On the other hand, the cost is heavy ($150-200 per acre), the sprinklers may get out of order, there is loss by evaporation although this is set off by absence of seepage, and some of the water may be lost by not getting to the ground through the trash. Careful measurements of growth and moisture conditions are being made, as between overhead and ditch irrigation and should provide interesting reading. The author concludes with the remark that this system is one of the most interesting developments in irrigation for some time, as it offers possibilities where there is shortage of water and very porous conditions of soil.

The remainder of this report is of less immediate interest, as in most cases the results of experiments are not sufficiently advanced for definite conclusions to be drawn. References are made in separate sections to the orchard system, the Baldwin flume system, the Waipio system, ditches and their lining, methods of recording the successive irrigations in the fields, trash panis, water measurement, concrete gates, etc. The tendencies observed by the author during his recent comprehensive tour include the following:—shorter level ditches where water is the problem, if water is short the old "one-line-one-line" is considered the best; lines are shorter, 30-35 ft. water courses are coming into vogue; the importance of getting water quickly on to the ratoons is becoming more generally recognized, especially for H 109; a tendency in many places to leave wide pathways along the water courses may be checked by using the Moler-Oelson planting machine; more and more electric pumps are being installed, and semi-diesel engines are increasing in numbers owing to the low price of oil; and a greater interest is being shown in determining the total amount of water going on to the fields, for which the orifice type of instrument is fitted.[1]

He concludes by drawing attention to work on drainage. Hitherto the open drain system has been universal in Hawaii, but various experiments are being now made with tile-draining. R. H. Hart, of the Bureau of Public roads,

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[1] For a description of the different systems of irrigations referred to, see *I.S.J.*, 1923, pp. 180-184, 401-408 and 455-461.

United States Agricultural Department, visited the islands and studied the drainage system on a number of estates; his report is expected shortly. Ewa plantation is making an experiment with tile-drainage on a 58-acre field according to a scheme drawn up by the office named, and it is hoped that various questions will have further light thrown upon them; such as the profitableness of the system, its effect on yields, ripening and sugar content, the leaching out of accumulated salts, effect of root growth, together with the best distances apart and depth of the drains, and, lastly, the effect on nitrogen, phosphorus and potash applied in manures. The advantages claimed for drainage are summarized as follows:—removal of harmful salts, lowering the water table and rendering it uniform, removing excess of water, better aerating the soil, raising the soil temperature, deepening the root range and producing better quality of juice.

C. A. B.

Cause of the Difficult Filtration of Solutions made from Hawaiian Raw Sugars.[1]

By WALTER E. SMITH

(Continued from page 269).

Determination of Turbidity.

It has been observed that the factories producing good filtering sugars have clear clarified juice, and for purposes of comparison the turbidity of juices has been measured from time to time at different factories. This is done by determining the height of liquid through which light can pass without being totally absorbed. In one form of the test, black lines are ruled on a white surface, a Nessler tube is placed over the lines and juice is poured into the tube until the visibility of the black lines is just extinguished. The Kopke turbidimeter consists of a small porcelain plate on which black lines are drawn, the plate being attached to a graduated glass tube, open at each end. The instrument is lowered into the solution until the lines are no longer visible, the finger placed over the upper end of the tube, and the turbidimeter removed from the solution. The depth of immersion is measured by the height of the column of liquid retained in the tube, the figures being inversely proportionate to the clearness of the juice. That is, with a turbidity of 5 it is possible to see through twice the height of liquid indicated by a turbidity of 2·5.

Nature of the "Cloud."

Various writers intimate that the cloud of clarified juice may be silica, or calcium silicate, in colloidal suspension. Our findings do not substantiate any such theory, and indicate it to be principally cane wax. In many determinations of the ash of the non-settling matter of clarified juice, we have found it to be from 2–3 per cent. only, consisting of iron and calcium, no doubt from soil adhering to the cane. To determine the wax, 300 c.c. of turbid clarified juice was filtered through kieselguhr, which was washed free from sugar, dried, and extracted with ether for eight hours, the amount being found to be equal to 92 per cent. of the organic non-settling matter present in the clarified juice. If the extraction had been continued for a 16-hour period, probably an even greater amount of wax would have been obtained.

FACTORS AFFECTING TURBIDITY.

No conclusive investigation has yet been made into all the factors which affect the turbidity of clarified juice, but the work of H. F. BOMONTI on clarification showed that the presence of phosphoric acid has a decided influence on this factor. This theory is substantiated in data set out in the inspection reports of W. R. MCALLEP and W. L. MCCLEERY. It has been noted that juices containing 0·030 per cent. of P_2O_5 or more, will usually give clear clarified juice; below this figure it is likely that the juice will be more or less turbid.

Data indicate marked differences between the phosphoric acid contained in different varieties of cane, and also between the cane from different localities. Further, that for a given quantity of phosphoric acid different varieties of cane respond differently in clarification. It seems likely that the turbidity is affected both by the amount of phosphoric acid and of the wax contained in the juice.

In general, laboratory clarification tests indicate almost invariably that with sufficient lime, mixed juice high in phosphoric acid will give clear, limpid, clarified juice, but in actual factory practice it often happens that juice with sufficient phosphoric acid to give limpid clarified juice is not sufficiently limed to bring about this result. This condition is largely due to the fact that the original filter station capacity of our mills was designed to handle the quantity of settlings from acid or neutral clarification, and not the greater quantity of settlings from the more alkaline clarification developed during the past two years.

INFLUENCE OF CANE VARIETY, AND LOCALITY ON JUICE TURBIDITY.

The filtration rates of sugars produced on Hawaiian plantations have been arranged in the order in which they occur geographically, starting with Hutchinson plantation and proceeding around the coast counter-clockwise. A most significant fact is shown in this graph plotted from these figures. The peak in the curve occurs on the Hilo coast, the district of greatest rainfall, with every plantation from Waiakea to Laupahoehoe producing good filtering sugars, the sugar from Hilo, Onomea, Pepeekeo and Honomu being particularly good. These plantations grind principally Yellow Caledonia cane, known generally to contain but little wax, here grown under conditions of abundant rainfall and humid atmosphere.

It is also to be noted that this section of the country is characterized by soils high in available phosphoric acid, particularly indicated by a failure to secure response from the application of phosphate fertilizer in this section. In the four plantations mentioned, the phosphoric acid in the mixed juice is usually about 0·04 per cent. or higher, and it is significant that the clarified juice is very clear and free from cloud, the resulting sugars having excellent filtering qualities.

Our information shows a tendency for juice from H 109 cane to give more turbid clarified juice, even when it contains phosphoric acid sufficient to give clear juice with Y.C. cane. In general, it seems that H 109 is higher in wax, and likewise it does not seem to have the property of taking up phosphoric acid from the soil equal to that of other varieties.

On the whole, there is a marked difference in the phosphoric acid contained in juices from Y.C. and D 1135 cane grown on the same plantation. This is probably due to the fact that the Y.C. is grown on the lowlands, below the elevation of 800 ft., while D 1135 has been found adaptable for the higher elevations. In a great many places the phosphoric acid found in D 1135 is extremely low, and insufficient to give satisfactory clarification. At Pioneer Mill, however, D 1135 is grown at low elevation, and in this case no marked deficiency in phosphoric acid is noted.

EFFECT OF CLARIFICATION ON FILTRABILITY.

In order to determine the effect of clarification on the filtration rate of the resulting sugar, a complete experiment was carried out on this point at Waipahu. To ordinary mixed juice, phosphate fertilizer was added, bringing the phosphoric acid content to 0·05 per cent., the cold mixed juice limed until alkaline to phenolphthalein, heated to the boiling point and allowed to settle. The clarified juice decanted was especially brilliant and clear with a turbidity of 10·0 cm.; this juice was concentrated to syrup and boiled to grain in a 30-gallon vacuum pan. The massecuite was spun in a small centrifuge, and sugar was made at three different purities by varying the amount of wash-water used. The sugars resulting from this experiment gave the highest filtration rate yet recorded, and considerably higher than strikes boiled out of the syrup found in the regular process. At no time has the clarified juice at Waipahu been nearly as clear as was that produced in this experiment. Analysis for suspended matter also showed that the non-settling matter in the clarified juice at that factory is from four to six times as great as was found in the juice made in this experiment.

Generally speaking, the filtration rate of syrup is perhaps a fair index of the filtration rate of sugar made therefrom; advantage of which fact was taken in determining the effect of removing cush-cush from the mixed juice prior to liming and heating, as it would obviously be very difficult to carry such an experiment to the stage of making sugar from the different juices. Equal portions of juice were taken from the mixed juice pump at Waipahu, one bucketful being screened through a 100-mesh screen, the next bucketful being poured into a tank without screening, thus assuring absolute similarity of the respective portions of juice. To each tank an equal amount of lime was added, the juice brought to the boiling temperature, and allowed to settle for one hour. At the end of that time, the juice was decanted and concentrated to syrup; the two syrups were then diluted to 50° Brix. and the filtration rate determined. The regular unscreened juice gave a rate of 40·4, while the screened juice gave a rate of 49·2, a difference of practically 9 per cent. Just what this would amount to in the sugar is difficult to estimate, but it would undoubtedly have some beneficial influence since the difference in filtration rates was due to an actual difference in the amount of non-settling matter, as indicated by the non-settling matter in 25 c.c. syrup at 50° Brix diluted to 100 c.c. and centrifuged for 10 minutes, found to be as follows:—

Unscreened juice	0·0343 per cent.
Screened juice	0·0289 ,,

It is difficult to determine the effect of such a factor on a large scale because of the great variation in other factors affecting clarification. It is interesting to note, however, that a sample of sugar made while the Peck screen was in operation at Kahuku gave the highest filtration rate with the pressure apparatus of any commercial sugar tested. Apparently, the elimination of the cush-cush from the mixed juice makes better conditions for the precipitation of cane wax. Since the action of the phosphate precipitate seems to be largely instrumental in removing the wax from juice, it seems reasonable that the removal of the cush-cush permits more concentrated action directly on the wax particles. It has been suggested that the cush-cush removed actually contains some quantity of wax, and that its removal therefore results in better clarification, but the wax in this small amount of cush-cush would be too small to materially affect the whole situation. Data taken as a whole suggests that the removal of cush-cush by screening might improve clarification to a marked degree.

IMPROVEMENT OF CLARIFICATION.

In order to produce good filtering sugar the principal object must be to produce clear, wax-free clarified juice. Preliminary information indicates that wax is contained in the final molasses to the extent of several tenths of a per cent., in extreme cases perhaps reaching nearly one per cent. Herein may lie the explanation of a good portion of the difficulty in working low grade products and reducing molasses purities, and should later investigation prove this to be the case, an opportunity is presented for additional recovery in the boiling-house. It seems certain that cane wax should exert a definite influence on purging, and from this viewpoint the extra recovery of sugar from molasses by the elimination of cane wax from the process would make it profitable to go to some additional expense to do so. This object may be attained in one of two ways, each of which seems worthy of discussion.

(1) Our work indicates improvement in clarification by the addition of phosphoric acid. Further investigation will be necessary to determine whether it will be profitable to add phosphoric acid to juices known to be deficient, and the question must be viewed both from the economic standpoint as well as from the chemical.

(2) Perhaps the cheapest and most effective method for the removal of wax from turbid clarified juice would be a kieselguhr filtration with pressure apparatus such as the Sweetland filter, no insurmountable difficulties should be presented by such a plan, and investigation on a factory scale with full size equipment could readily determine the cost of such filtration, as well as the actual benefits to be derived. Apparently, there is a precipitation of further quantities of wax from the syrup on concentration, so the amount of this precipitation would determine whether the syrup or the clarified juice should be filtered. Whether the syrup would be too difficult to filter can only be determined by actual experiment.

EFFECT OF THE BOILING SYSTEM ON WAX ELIMINATION.

Assuming now that clarification is complete, and the juice concentrated to syrup, how can the suspended matter and the cane wax be best eliminated from the process? To what extent does the boiling method affect this elimination?

At this time there are two principal systems of boiling: One, sometimes called the "two-boiling system," takes back molasses into each strike, boiling more or less to constant purity of massecuite, and only occasionally boiling a straight strike in which no molasses is taken back. The other system, sometimes referred to as the "Pioneer system," produces three grades of commercial sugar known as A, B and C sugar by the following scheme: The first strike (A) is seeded with low-grade sugar, finishing with syrup and remelt; the molasses from this A strike is taken into the next strike (B), the molasses from this B strike going into the next pan (C). All the molasses from the C strike goes to the low-grade pan, the next strike being the A strike of a new series. In this way there is a definite elimination of the non-sugars, without the possibility of circulation over an indefinite period.

In order to determine the effect of such a system of boiling on the filtering qualities of sugar, a number of tests were made at Pioneer Mill; fortunately, it was possible to secure sugar made from both alkaline and acid clarification. In each test, three samples of sugar were made from each massecuite at different polarizations covering a range of several per cent. Thus it was possible to prepare a graph expressing the results of each test, showing a comparison between different sugars at any desired purity within the range.

It was found that at any given purity the A sugar gives a higher filtration rate than B sugar of equal purity in both alkaline and acid clarification. Unfortunately, the results shown for alkaline clarification are not entirely consistent in that the C sugar shows higher than the B sugar; this can be explained on the basis that a change in the quality of the syrup might be responsible, or since the molasses taken into the C strike was from the previous B strike, it might be of much different quality than the B strike in question. In the acid clarification no irregularities occur, and the respective filtration rates at equal purities show a very regular relationship. In short, at equal purities the A sugar has a higher filtration rate than the B sugar, which is similarly of better filtering quality than C sugar of the same purity. Similarly, in each case the sugar made under alkaline clarification is of better filtering quality at any given purity than the sugar made under acid clarification.

The difference between A, B and C sugar is readily explained in the light of data according to which the factor "Fine Suspended matter ÷ Non-sugars" was plotted against true purity of the sugar represented. The ratio of fine suspended matter to non-sugars was shown to be less in A than in B sugar, and less in B than in C. Apparently, there has been a concentration of the wax into the C strikes, the A sugar therefore having been boiled from a massecuite in which the ratio of fine suspended matter (or wax) to non-sugars is less than in the subsequent strikes.

While the small amount of data available at this time is not sufficient to permit a definite statement on this point, it seems logical that this system of boiling might result in a quicker and more complete elimination of the wax to the low-grade products and final molasses, than where molasses is constantly circulated without a definite, clear-cut elimination, often enough to make sure that wax is not permitted to concentrate in the sugar end-products. That constant return and reboiling of non-sugars is not of itself responsible for poor filtering qualities of sugar, however, is seen in the fact that many of the factories producing the better filtering sugar follow the "two-boiling system," while the "Pioneer system" does not of itself produce good filtering sugar. It is more than likely, however, that such a system of boiling will improve the filtering quality of the sugar over what it would be with the two-boiling system.

A great deal of work was done in this investigation to determine the effect of using low-grade seed. A number of strikes were boiled in an experimental pan at Waipahu, and filtration tests made on the resulting sugars, together with determinations of suspended matter. The usual plan of procedure was to set aside sufficient syrup and molasses for two strikes; one would be boiled, seeding with low-grade sugar, while the other would be grained on syrup, but taking in as remelt the same amount of low-grade sugar as was used for seed. In this way strikes were made of straight syrup, of syrup and remelt, and of syrup, remelt and molasses. From each strike sugar at three polarizations was tested, and the results graphed for comparison. In every case it was found that the strike gained on syrup gave sugar of better filtering quality than did the duplicate strike which used low-grade seed as the basis of the crystal.

In studying data comparing grained and seeded strikes, the ratio between non-sugars and non-settling matter is one of great importance. Assuming, for the moment, that the non-settling matter is contained in the film of molasses surrounding the crystal, the removal of this molasses by washing should remove equal parts of non-sugar and non-settling matter if the two are distributed equally. It has been observed, however, that in the seeded strikes this ratio actually increases with increase of purity. This leads to but one conclusion, that the low-grade sugar which constitutes the basis for the crystal must actually contain a greater proportion of this non-settling matter. Confirmation of this theory is found in the fact that sugars grained on syrup do not show this ratio increase. In a series of eight strikes, the samples of sugar representing the grained strikes either show a decrease in this ratio, or remain practically constant without showing the increase noted in the needed strikes.

The actual increase in filtration rate due to graining is only slight, however, and it is unlikely that the advantage gained in filtrability would be sufficient to offset what advantages might be gained by the use of low-grade sugar as seed. Other considerations might indicate the advisability of remelting all the low-grade sugar, and its use in this form rather than as seed; but speaking only from the standpoint of filtrability it is doubtful whether much real benefit would accrue therefrom.

A point very definitely shown in all the work, both at Pioneer Mill and in the strikes boiled at Waipahu, is that for any given massecuite the filtration rate of the resulting sugar is increased materially by increase in polarization, or purity.

While of course, many factories could not improve the filtrability of their sugar by the small increase in polarization which was possible previously, a material increase in filtrability would follow a general rise in polarization permitted under the new schedule.

FILTRATION OF REFINERY LIQUORS.

Experiments with our pressure test indicate one more possibility for improvement of the general filtrability situation, but further work will need to be done in conjunction with the refinery technologists before the actual feasibility of the plan can be determined. We have found in the study of four different sugars that the addition of lime to the liquors obtained on re-melting them decreased the filtration rate, the decrease being somewhat in proportion to the amount of lime added. In each case, the raw sugar dissolved without the addition of lime gave a reaction slightly alkaline to litmus; but when sufficient lime was added to bring the reaction alkaline to phenolphthalein the result of the filtration test was always consistently lower.

These facts indicate that an increase in filtrability of all sugars, both good and bad, might be brought about at the refinery if it is possible to operate at a lower alkalinity, or if some scheme can be devised to increase the alkalinity with lime or other alkali after filtration. Perhaps, such a plan might be entirely impracticable, but it is worthy of further investigation.

It was not possible to include in this report comparative data pertaining to Cuban sugars; but it is interesting to note that three samples of Philippine sugars gave the lowest filtration rates of any tested with our pressure filter, only slightly better than our poorest filtering sugars according to the Elliott test.

Giving each factory a standard rating as to slicing capacity, and requiring each factory to attain exactly the same standard of extraction for beets of a certain sugar content of purity, a "pennant race" has been instituted by the Great Western Sugar Co. among the 16 factories it controls[1] This plan has had an effect which has surpassed expectations in developing team work in crews made up to a large extent of temporary men. It has demonstrated further that in a beet factory high capacity and high extraction go together, and thus has disproved the idea that maximum capacity can be obtained only by a sacrifice in extraction. The greatest gain has been in the loss of sugar taking place between the harvesting of the roots and their slicing (amounting on an average to 1 lb. of sugar per ton of roots when stored in piles in the territories concerned). Most European factories require from 1 to 2 man-hours per bag of sugar; but, during the last two campaigns, all the factories of the Company have averaged 36 mins. for one man to produce one bag of sugar, while the factories with the best records do this in only 29 mins., which is believed to be a figure unsurpassed anywhere.

Facts about Sugar, 1924, 16, No. 5, 106-107.

Brevities.

Oil of cinnamon is stated by Henri Courtonne[1] to possess in the case of beet juice an antiseptic power equal to that of mercuric chloride, no loss of sugar being observed during one month in juices preserved by means of this essential oil.

According to a writer in the *Cuba Review* the mosaic disease is daily attracting more attention from sugar producers in Cuba, who are at last awakening to its dangers. What those dangers are has been pretty thoroughly explained by Mr. A. H Rosenfeld in a recent article in our pages.[2]

In Mauritius the Cie. Sucrière de St Antoine has commenced the production of an alcohol motor fuel under the name of "Clarine"[3] consisting of alcohol at 96°, 79·2 per cent.; pyridine, 0·4; Simonsen's oil, 0·4; and ether, 20·0, a little methyl violet being added for colouring. This mixture has given entire satisfaction in experimental trials.

The estimates about the end of May of the extent of the present Cuban crop were in the case of Guma-Mejer 4,075,000 tons and in that of Mr. Himely 4,050,000 tons. Willett & Gray report that the production to May 24th was 420,000 tons more than to the corresponding date in 1923. Heavy rains were general throughout the island during May.

An option has been secured in Vancouver on a site for a plant to manufacture "Natalite" alcohol-ether motor fuel. In addition to motor spirit, the proposed plant will produce yeast, ethyl alcohol, industrial alcohol, anesthetics, fertilizers, and varnish materials. The company expects to begin with an initial output of 2,500,000 gallons per year.

E. O. von Lippmann[4] reports that the blind end of a pipe connected with the steam exhaust of the boiler-house of a beet factory was found to be filled with almost pure urea, which pipe had been screwed up and had long been unused. It is suggested that the urea had been formed by the isomerism of ammonium carbonate, which has previously been found in the steam exhaust lines of beet factories.

In his Budget speech, Mr. Philip Snowden, Chancellor of the Exchequer, mentioned that it had been possible to make arrangements under the existing law by which methylated spirits sold to the public for domestic purposes shall contain an additional nauseous denaturant, the object being to check the drinking of such spirits reported to be prevalent in certain quarters. This addition is probably Simonsen's oil[5] (the distillate below 300° C. from crude mineral oil).

According to experiments recently conducted in the Philippines,[6] the loss of sugar from topping cane previous to cutting amounted after the first 24 hours of such delay to one-sixth of a picul (22½ lbs.) for every ton of cane, and to one-third of a picul (45 lbs.) after three days' delay. Cane cut and allowed to lie in the field showed a loss of sugar of one-third of a picul (45 lbs.) for every ton of cane after 24 hours, and two-thirds of a picul (90 lbs.) after four days' delay in loading after cutting.

A new publication to be called *Chemical Reviews* is being issued quarterly by the American Chemical Society. It will be devoted to articles by specialists consisting of reviews or essays not essentially composed of the results of their personal research, the object in view being to bring before chemists a large number of important topics which, owing to lack of space, have not been made generally available in the other publications of the Society. It will be issued quarterly, and the subscription to it will be $4·00 per annum.

To encourage the production of as high a quality of sugar as possible in Mauritius, Messrs. Stafford Mayer & Co., Ltd., of that island have recently generously offered a Gold Challenge Cup (to be held for a year) to be won by the factory producing the best all round white *vesou* sugar suitable for direct consumption in the United Kingdom market, the test to extend over the complete output of the factory during a season. At Messrs. Mayer's request the Chamber of Agriculture appointed a Committee to award the Cup, which has been won the first season by the St. Antoine Estate, while Riche-en-Eau and Britannia Estates received honourable mention. This is a method of encouraging high-class sugar production that might be extended to other of our sugar colonies.

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[1] *Bull. Soc Ind. Rouen*, 1923, 51, 32–35. [2] *I.S.J.*, 1924, pages 194 and 195.
[3] *La Revue Agricole*, 1923, 35, 129. [4] *Berichte*, 1923, 56. 566-567. [5] *I.S.J.*, 1920, 585; 1921, 326.
[6] H. A. Lee, "Second Annual Report of the Philippine Sugar Centrals Agency." Manila, P.I.

Brevities.

Distillery slops or vinasse when applied directly to cane fields produces a harmful result on account of its acid reaction. Therefore **Nathan Levy**[1] advises that as soon as produced during the campaign it should be run into a reservoir, in which also are dumped the bagasse furnace ash and the filter-press scums. This reservoir is constructed of sun-dried bricks, and is shallow, so that on exposure to the sun its contents dry up to some extent. When the reservoir is full, it is left to itself for 10 or 11 months, after which the pulverent mass is applied to the cane fields.

The plant recently built by Commercial Alcohols, Ltd., on the Montreal harbour front has a capacity of about 1500 gallons of spirit per day, and contains the most modern approved equipment obtainable.[2] Steel tankage is provided for 900,000 gallons of molasses, the raw material used, the steamer discharging at the rate of 30,000 gallons per hour, using a Kinney rotating plunger pump with very good results. The plant is described as being unique in that it is the only one in Canada employing a certain type of pure yeasting and continuous rectifying apparatus.

Dr. **Kleine**, who has spent some time in the Belgian Congo and in Rhodesia studying sleeping sickness, claims to be able to cure this malady by means of "Bayer 205," a synthetic drug, the composition of which has not been divulged. He states that he succeeded in curing patients in all the three stages. In some the deterioration of the nervous system was so far advanced that a restoration to normal health was not longer possible, but the blood of these cases was rendered free of trypanosomes, the individuals concerned no longer being sources of infection.

Many industrial laboratories have already freed themselves from the tradition which imposes isolation for the chemical balance, points out N. H. A. **Krayer**,[3] improvements in the structure of buildings and in ventilating systems having removed the two most potent excuses (namely, vibration and fumes) for the absence of this apparatus from the working bench. He argues that the few advantages of such a room in plant laboratories do not compensate for the economic waste involved (space, time, and labour), and urges that when designing new laboratories a place for the balance should be provided at or near the work table.

"Suchar" decolorizing carbon is reported by W. H. **Dunstone**, Jr., as having operated with success at Southdown, La. A yield of 94·28 lbs. of standard granulated white per 100 lbs. of 96° raw sugar was obtained.[4] The process is stated to have worked successfully in every way, due mainly to the uniformly high decolorizing power of this carbon after revivification, which was accomplished in an electric furnace. In fact it is claimed that after each reburning the carbon was restored to its original activity. A new type of filter, called the "Auto," the invention of Mr. J. J. **Naugle**, President of the Suchar Process Corporation, was used for the separation of the carbon and sugar liquor with satisfactory results.

Colloidal copper hydroxide is stated by H. D. **Hooker**, of the University of Missouri, U.S.A., to have given remarkably promising results as a fungicide, in comparison with both Bordeaux mixture and lime-sulphur wash. He describes the method of its preparation, and then goes on to say that "complete protection was afforded from both scab and blotch by the weakest concentration of the colloidal copper hydroxide used (0·019 per cent.) and this spray produced very little burning, much less than 3 : 4 : 50 Bordeaux and very little more than lime-sulphur"; while the amount of copper used was 1/15th that in 3 : 4 : 50 Bordeaux mixture. An even more dilute concentration may give adequate protection and no burning.

Foreseeing the possibility of severe competition as the results of the extension of cane plantations in the tropical province of Jujuy, Argentina, Dr. W. E. **Cross**, Director of the Experiment Station, Tucumán, has turned his attention to the question of establishing the beet industry in his province,[5] the scheme being that Tucumán factories should work with cane as at present, and later in the year work up the beet crop, overhead expenses and interest on capital thus being lowered, and permanent employment given to the staff and work people. As the result of his preliminary experiments, he concludes that they offer "a certain promise of the possibility of successful cultivation," and he intends to carry on the investigations this year on a larger scale.

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[1] *Bull. Assoc. Chim. Sucr. Dist.*, 1923, **41**, 207-209.

[2] *Canadian Chemistry and Metallurgy*; through *The Chemical Trade Journal*, 1924, **74**, No. 1928, 532-533.

[3] *Industrial and Engineering Chemistry* (*News Edition*), 1924, **2**, No. 6, 8.

[4] *La. Planter*, 1924, **72**, No. 2, 39.

[5] *La. Planter*, 1924, **72**, Nos. 10 and 11, 192-193, 212-214.

Publications Received.

Hot-Water Treatment of Sugar Cane for Insect Pests—a Precaution. P. A. Yoder and J. W. Ingram. Department Circular 303; U.S. Department of Agriculture. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.).

The hot-water treatment of cane for the destruction of insect pests,[1] suggested by Dr. E. W. BRANDES, of the Office of Sugar-Plant Investigations, Bureau of Plant Industry, has much of promise for reducing or eliminating infestation, especially with reference to moth borer (*Diatraea saccharalis crambidoides* Mask) and cane mealy bug (*Pesudococcus calceolariae* Mask). Recent tests are reported in this Circular from which it seems apparent that without further investigations it must be considered unsafe to subject to the hot-water treatment (30 min. at 50° C.) cane that has sprouted extensively during winter storage, or if such cane is so treated it may be necessary to plant much thicker in order to secure a normal stand.

Manual of Dangerous Insects likely to be introduced into the United States through Importations. Edited by W. DWIGHT PIERCE. (Government Printing Office, Washington, D.C.)

Host plants are arranged alphabetically by the common American name, and a brief sketch with numerous illustrations is given of the more important species of dangerous insects, a good amount of space being devoted to those attacking *Saccharum officinarum* and *Beta vulgaris*.

Lime and Magnesia. N. V. S. Kniggs, B.Sc., F.C.S. (Ernest Benn, Limited, 8, Bouverie Street, London, E.C. 4.) Crown 4to. ; over 400 pp. ; 48 illustrations. 1924. Price : 30s. nett.

Some of the contents of this work include : The General Chemistry of Lime; the Physical and Chemical Properties of Lime ; the Chemistry and Physics of the Hydration of Lime; the Analysis and Testing of Lime and Magnesia; the Winning of the Raw Material; the Process of Lime-burning; the Uses of Lime and Magnesia.

Trade Notices.

Lafeuille System of Crystallization-in-Motion. (Soc. Anon. des Ateliers de Construction de J. J. Gilain, à Tirlemont, Belgium.)

By this new process, the so-called "rotative tabular mixer," it is claimed the old methods of crystallization are revolutionized, a comparatively great rapidity of cooling being possible without the formation of false grain. Instead of the usual form of mixer, that is a stationary tank in which the massecuite is stirred by means of suitable gear, the new principle consists of a cylindrical tank which turns on rollers and is provided with tubes through which circulate the cooling water. In this way the massecuite contained in the tank is turned over on itself as gently and as slowly as may be desired without a single portion of it escaping the movement or avoiding the cooling effect. Then instead of adding molasses to the massecuite during its cooling with the pretext of building up the grain, but actually to correct the thickening of the mass, no addition at all is made in the tubular rotative mixer. Cooling, which is effected with a rapidity previously unknown, is pushed *à fond*. One hour is sufficient with rich refinery massecuites, and 18 hours with molasses massecuites; while, as stated, there is no false grain, and a higher yield is, moreover, obtained. In the cane sugar factory with a massecuite having a purity of 90° ordinary conditions may give a yield of 48-50 per cent. in 24 hours, but with the tubular rotative mixer it is claimed 60-65 per cent. will result in only two hours. Summing up its principal advantages, these are stated as :—A very considerable increase in the yield (viz., 20-30 per cent.); improvement of the quality of the sugar; suppression of the return of molasses; great facility of centrifuging; and economy of fuel, time, motive power, and of space.

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[1] *I.S.J.*, 1923, 236.

Review of Current Technical Literature.[1]

QUESTION OF THE FORMATION OF COMPOUNDS BETWEEN SUGARS AND SALTS (IN CONNEXION WITH THE VALIDITY OF PRINSEN GEERLIGS' THEORY OF THE FORMATION OF MOLASSES. (1) *I. M. Kolthoff. Archief, 1923, 31, No. 12, 261-269.* (2) *W. D. Helderman. Ibid., 1923, 31, No. 12, 269-271.* (3) *I. M. Kolthoff. Ibid., 1923, 31, No. 32, 799-802.*

(*1*) HELDERMAN about three years ago[2] concluded from investigations carried out according to the phase theory that no proof is to be found for the existence of true compounds between sugars and salts (e.g., sucrose and sodium chloride), such as are considered to exist in molasses according to the hypothesis for its formation elaborated by Dr. PRINSEN GEERLIGS. Although certain crystalline substances containing sugar and salt are known, and the proportions of these two constituents are apparently stoichiometric, yet according to HELDERMAN it is by no means certain that one is dealing with true chemical compounds, since these proportions may be such only by chance. Dr. KOLTHOFF here controverts these conclusions, and disputes the validity of the results obtained by the phase theory experiments. He believes that true molecular compounds of sucrose and salts actually exist, remarking that according to phase theory a compound may be present in solution, while under no conditions can it be in equilibrium with a solution as solid phase, notwithstanding any excess of the components present. Phase theory experiments are here described in detail in support of this view, and three graphs illustrating them are given. As the result of repeating Helderman's tests, but working at 18°C., instead of at 30°C., it is concluded that this chemist obtained meta-stable solutions only, since he did not wait sufficiently long to allow the compound to crystallize out of solution. Following this, the crystalline "compound" of sucrose and sodium chloride, corresponding to the formula $C_{12}H_{22}O_{11} \cdot NaCl \cdot 2\,H_2O$, was prepared, and examined according to phase theory, the conclusion being reached that the compound in question is a stable one in respect of its saturated solution, having in fact a high degree of stability. His final conclusion is that "the crystalline compound of sucrose and sodium chloride complies with the conditions which represent a true compound."

(*2*) Dr. HELDERMAN replies to the article summarized above by pointing out that the experiments were carried out at 18°C., whereas his were made at 30°C.; so that although Kolthoff's experiments may be valid for 18° it is not possible to draw from them conclusions which on the whole apply also at 30°C. In regard to Kolthoff's final conclusion (stated at the end of the last paragraph), Dr. HELDERMAN remarks that he has never denied this expression of opinion, and in his experiments he only intended to prove that at 30°C. sucrose and salts do not form compounds which at this temperature can occur as a stable phase in respect of their saturated solutions. He has never expressed the opinion that such compounds are not obtainable in some way or other in the crystalline state, for the simple reason that the molasses question concerns solutions, and the existence of crystalline compounds is of no importance so long as these same compounds cannot occur in equilibrium with their saturated solutions. Regarding the phase theory experiments as carried out by KOLTHOFF, these are criticized as having no validity, since in most cases only the saturated solutions were analysed without an analysis being made of the solid phase.

(*3*) Dr. KOLTHOFF answers these criticisms as follows: His experiments were carried out at 18°C., it is true, but for the reason that, since the heat of formation of the compound $C_{12}H_{22}O_{11} \cdot NaCl \cdot 2\,H_2O$ is small, its stability cannot depend much on the temperature. At any rate, he has now repeated his experiments at 30°C., and has obtained quantitatively the same results as formerly, thus proving his point. Helderman's criticism that the solid phase existing in equilibrium with the saturated solution had not been analysed is answered in a similar way, namely by presenting figures showing a proportion of 9·92 ml. of sucrose and 10·0 of sodium chloride per 100 of water, as demanded by theory. He has also made experiments with the object of determining the thermal transition point of the compound in question, viz., $C_{12}H_{22}O_{11} \cdot NaCl \cdot 2\,H_2O$, but found it impossible to detect any change, his final conclusion from these and other experiments being that the compound certainly exists and is stable at 30°C. In any case (he remarks) HELDERMAN experimented in a faulty manner, in that he did not allow his solutions to attain supersaturation. If he had done this, he would have obtained a different graph entirely for the system sucrose-sodium-chloride-water. Lastly, he expresses the opinion that, apart from considerations according to the phase theory, it seems extremely improbable that substances such as sucrose and sodium chloride should form mixtures of crystals, since both belong to different crystalline systems. Furthermore, it must appear very extraordinary that such mixtures of crystals should always consist of equivalent quantities of sugar and salt.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1921, 509; 1922, 213.

UTILIZATION OF THE WASTE HEAT OF FLUE GASES BY RETURNING THEM TO THE FURNACE GRATE. H. Claassen. *Centralblatt für die Zuckerindustrie, 1924, 31, No. 43, 871-872.*

After a discussion of the relative coal consumption when applying various systems of utilizing the flue gases for heating in the boiler house and pulp-drying house, Dr. CLAASSEN makes an interesting proposition according to which the flue gases may be used to advantage in another way. He points out that these gases still contain 8-10 per cent. of oxygen, and are therefore still capable of supporting combustion; and he proposes that they should be returned to a suitable spot under the grate, so as to effect an economy in the amount of heat required for raising the temperature of the furnace gases to the necessary degree. This return should be made where the coal has been de-gasified and the gases strike against glowing coke; and when there are three or four boilers in the plant the waste gases from the third or fourth may be divided between the furnaces of the other two or three. Working in this way during two campaigns, the flue gases were returned in such amounts that the CO_2 of the furnace waste gases was 11 to 12 per cent., whilst without their return the figure was 9 to 10 per cent., the temperature of these waste gases remaining the same in both methods of firing. It is, of course, necessary to see that the CO (carbon monoxide) content of the furnace waste gases is not increased, and consequently chemical control must be performed with greater care than usual by means of average gas analyses, the return of the flue gases being thus regulated. Even in furnaces of ordinary construction, a considerably improved effect has been obtained in the firing of the two water-tube boilers, experiments having been carried out during four successive days in which the waste gases from the one boiler were drawn off by a fan and blown into the lower part of the ash-pit of the other. The gases before and after returning were examined on each shift, the average results of these analyses being as follows: Boiler I, $CO_2 = 9{\cdot}4$ per cent.; $CO_2 + O = 19{\cdot}15$; temperature $= 375°$ C. Boiler II, $CO_2 = 12{\cdot}1$; $CO_2 + O = 18{\cdot}9$, temperature $= 372°$ C. From data collected it was possible to calculate that in Boiler II, per kg. of coal burnt, 4·9 kg. of air at 20° C. were replaced by 4·9 kg. of waste gas at 375° C., which corresponds to a gain of 450 calories, or to 6·4 per cent. of the coal consumption.

MULTIPLE EFFECT EVAPORATION UNDER PRESSURE IN THE BEET FACTORY. (1) S. Ulrich. *Centralblatt für die Zuckerindustrie, 1924, 32, No. 22, 318-322.* (2) Rümmler. *Ibid., 1924, 32, No. 24, 368-370.*

(1) During some years past, experiments on the concentration of beet juice in multiple effect evaporators under pressure have been carried out on the Continent (notably with the Vincik-Turek system), and there are now ten factories in Czecho-Slovakia operating in this way. By adjusting the temperature of the heating steam, and of the area of the heating surfaces of the vessels, conditions can be obtained under which no caramelization of the beet juice occurs. No condenser, no air pump, and no thick-juice heater are required. Altogether the apparatus is simpler, several accessories being dispensed with; whilst its operation is easier, relatively little attention to it being required. But the great advantage claimed, one of particular importance at the present time in the Continental industry, is the steam economy it is possible to effect, the total consumption (including that required for the engines, and that lost by radiation and leakages) being in a triple not quite 50 kg.

of steam per 100 of roots. In the author's factory, the first in Germany to install the new system, this was found to correspond to a saving of 15 per cent., compared with the quadruple vacuum apparatus formerly used. In one of the Czecho-Slovakian factories in which the new system has been in operation, the total steam consumption during last season was as low as 42·5 kg., whilst a certain firm in Brünn guarantees that in their new installations the total consumption will not exceed 40 kg. Preparatory to adopting pressure evaporation at the Tschauchelwitz factory, the author had installed a new boiler-house plant giving steam at 12 atmos. (180 lbs. per sq. in.) and engines working at 2 atmos. (30 lbs.) back pressure, the exhaust being used for the first vessel of the triple and leaving the third at 105° C., that is a temperature fall of 20° C. The heating surface of all three vessels was only 895 sq. m. (9630 sq. ft.), and this served for the evaporation of the juice from 14,000 zentners (about 700 tons) of beets in 24 hours. Such a low steam consumption as 45 kg. can be attained even with a sextuple coupled with two juice-boilers working under vacuum in the usual way. According to the author pressure evaporation is the most important and valuable improvement that may be introduced into the German sugar industry.[1]

(2) This writer is not a partisan of multiple effect evaporation under pressure as described above; and suspects the danger of caramelization, doubts steam economy, and mistrusts operating with less than the usual supervision. He quite recognizes that the figure stated for the consumption of steam may have been obtained; but believes this to be due to the centralization of the engines, the high pressure of the return steam, and its utilization in the first effect, rather than to pressure evaporation as such.

Summary of Report on the Effect of Cold and of Hot Liming on the Removal of Albumin from Cane Juices. By *R. G. W. Farnell.* *Communicated to this Journal by The British Empire Sugar Research Association, London.*

Albumin is one of the colloids found in cane juices, and its elimination is necessary as far as possible. Although it is partially coagulated by heating the juice after liming, theoretical considerations have shown that it is much more completely eliminated by heating the raw juice and liming at the boil. This has been confirmed by laboratory experiments, details of which are described. Moreover, it has been found that less lime is needed for clarification when liming hot than when liming cold. Although the maximum removal of impurities (including nitrogenous substances) is only obtained by liming alkaline to phenolphthalein (pH 8·3 and over), it does not seem desirable in practice to exceed pH 8 owing to the large increase in the volume of the muds which settle very slowly and also owing to the danger of glucose destruction. It is, therefore, recommended to lime the boiling raw juice slightly alkaline to litmus, while still acid to phenolphthalein, this giving a pH of about 8.

Summary of Report on a Preliminary Investigation of the Colloids of Cane Juices and Molasses. *R. G. W. Farnell.* *Communicated to this Journal by The British Empire Sugar Research Association, London.*

It is now recognized that the clarification of juices is essentially the elimination of certain colloidal substances. The colloids in cane juice are responsible for the turbidity, and when concentrated cause great viscosity, which means slow boiling in the pan, so that the boiling-house work becomes congested. As the result, the massecuites may be discharged too soon, giving a low recovery of "available" sugar. Part of the colouring matter in cane products is due to a colloid, ferric tannate. Further, the frequent and annoying precipitates in the syrup are the result of colloids which also contribute largely to scaling in the evaporators. The manufacturer, and the refiner also, have much to learn from colloid science, a field which has hardly begun to be explored by sugar chemists. From a summary of work previously attempted in connexion with cane colloids, it transpires that these colloids have never been isolated and identified. Since this is necessary before we can devise methods for their removal, a preliminary investigation has been undertaken, the results of which are here epitomized. The colloids of the cane can be separated from the crystalloids by diffusion through a colloidal membrane, which is permeable to the crystalloids, impermeable to the colloids. This "dialysis" method has been applied to some final molasses, and also to a hand-expressed juice. The molasses contained 1·3-1·7 of colloids which consisted of pentosan (including pectin), protein, tannin, wax, and mineral matter probably containing silica. The juice was equivalent to a first-expressed factory juice and contained only a very slight amount of colloidal substance, i.e., 0·03 per cent. This amount would be much greater in a mixed mill juice from a factory, it being well known that the last-expressed juice contains very much more colloidal substance than the crusher juice. Unfortunately there were no factory juices available when this investigation was in progress. Studies on the pectin and pentosan, also protein, of the cane have been described in reports to the Association.[1] The relatively large amount or wax (i.e., 37 per cent.) isolated in the undialysable substance from molasses is striking, and points to the desirability of further investigation on this substance, whether it is present in the form of an emulsion, for example; there was some evidence that silica was among the colloids isolated, but it could not be estimated owing to the small amount available. Here, too, there is a promising line for future research.

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[1] Useful aticles dealing with the question of pressure evaporation in the beet industry are: "On Pressure Evaporation according to the Brodek type"; by Adolph Vincik; *Zeitsch. Zuckerind. Bohm.*, 1916-17, 41, Part 8. "On the Coloration of Juice during Evaporation under Pressure"; by Oskar Molenda; *Ibid.*, 42, Part 6. "Pressure Evaporation, and its Importance for Steam Economy in the Sugar Industry"; by A. Linsbauer; *Zeitsch. Zuckerind. Czechoslov.*, 47, Part 41.

CORRELATION BETWEEN THE ACIDITY AND THE COAGULABLE SUBSTANCES PRESENT IN BEET JUICE. *Ferdinand Kyrz. Zeitsch. Zuckerind. Cecho-Slov. Republik, 1924, 48, No. 21, 157-160.*

It was found that the acidity of expressed juice from beets in the final stages of ripening varied from 0·04 to 0·06 grm. CaO per 100 c.c., while the weather was mild and at times hot; this falling to 0·02 to 0·04 while wet; and rising to 0·06 to 0·09 grm. while frosty. Working with diffusion juice, it was found that the lower the Brix, the greater the amount of substances capable of being coagulated by Gonnermann's acetic acid test. Similarly, the lower the acidity, the greater the content of these coagulable bodies. Gonnermann's test failed to respond in the case of diffuser water (that is, the water left in the diffuser with the waste slices about to be discharged), though a precipitate resulted on the addition of alkali. Using Fehling's solution, and heating the liquid, the substances coagulable by alkali were determined in samples of various diffuser waters, and the correlation observed was that as these substances increase, so the acidity decreases.

QUESTION OF THE RELIABILITY OF THE DETERMINATION OF THE FINE GRAIN CONTENT OF MOLASSES BY KALSHOVEN'S METHOD. *H. I. Waterman and C. Visser. Chemisch Weekblad, 1924, 24, No. 1064, 78-82.*

Kalshoven's method of ascertaining the fine grain content of molasses[2] consists in determining the refractive dry substance of the sample with the fine grain still present in it (p), and also the same value after say 10 per cent. of water has been added to dissolve the grain (q), the grain content then being calculated from the formula: $100\,(p-q)/100-q$. This method has been regarded with much suspicion by certain workers,[3] who have produced figures which would appear to show that the results given by it are certainly subject to a large error. But the present writers believe that the procedure gives results that, though "not entirely exact," are at any rate "sufficiently correct." Their method of investigation was to centrifuge two samples of Java cane molasses in the inner bowl of a laboratory Sharples machine, thus obtaining grain-free and grain-rich portions which (together with the original sample) were analysed, their dry substance and sucrose percentages being found (by desiccation and by double polarization). In the case of Molasses No. 1, Kalshoven's method gave 3·5 per cent. as the grain content of the grain-rich portion; while the result calculated from the sucrose content of the grain-free and the grain-rich portions was found to be 2·8, or, in the same way from the dry substance values, 2·9 per cent. With Molasses No. 2, the grain content of the grain-rich portion by Kalshoven's method was 14·8 ; and when calculated from the sucrose content it was found to be 14·2 per cent. However, the authors pronounce their opinion on the results obtained from two samples only.

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[1] *I.S.J.*, 1923, 248, 630. [2] *I.S.J.*, 1919, 608. [3] *I.S.J.*, 1921, 337.

Use of Lime containing Magnesia (Dolomite Lime) for the Carbonatation of Beet Juices. *Franz Knor. Zeitsch. Zuckerind. Cecho-Slov. Republic, 1924, 48, No. 20, 149-153.*

Andrlik and Kohn[1] have shown that, contrary to the opinion largely held on the subject, the presence of a comparatively high content of MgO in the lime used for defecation in the beet factory is not harmful, and, in fact, is advantageous, since it produces somewhat lighter and purer juices. On the other hand, Bruhns[2] has reported the results of experiments dealing with the question, from which it was concluded that dolomitic lime shows no advantages as compared with ordinary lime. In order if possible to arrive at a definite decision in the matter, Mr. Knor has carried out a series of factory tests on defecation, using dolomitic lime (containing CaO, 62·05 ; and MgO, 18·44 per cent.), as compared with ordinary lime (containing CaO, 92·5 ; and MgO, 1·18 per cent.), raw juice, evaporator syrup, green syrup, and molasses being the products with which he experimented. A study of the results tabulated (indicating purity, ash, colour, etc.), however, indicates that in some cases the dolomitic lime gave somewhat better results than ordinary lime, whereas in other tests the contrary was the case. But what was definitely proved in all the experiments was that the magnesia present in the dolomitic lime in no way hinders the filtration of the juice after it has been defecated and carbonated, Andrlik and Kohn's conclusion[3] thus being confirmed. It is believed that this dolomitic lime (which occurs in plentiful deposits in certain districts in Czecho-Slovakia) may find use in the beet sugar industry.

Substances inhibiting Inversion present in Beet Molasses. *A. H. Erdenbrecker. Zeitschrift für angewandte Chemie, 1923, 36, No. 75, 585-586.*

In comparing the rate of hydrolysis of (*a*) a pure solution of sucrose (26 per cent.) and (*b*) a beet first molasses (of the same concentration) using in both cases the same quantity of N/1 sulphuric acid, and operating at the same temperature, viz., 70° C., the readings, as Ventzke degrees, were after the stated intervals of time as follows: 15 mins., (*a*) 2·0, (*b*) 30·0 ; 45 min., (*a*) — 6·8 ; (*b*) + 30·0 and 120 min., (*a*) — 7·0 ; (*b*) + 29·4, demonstrating strikingly the effect of impurities present in the molasses in inhibiting the inversion. These impurities are organic, and it is remarked that it would be of some theoretical interest to isolate and study them. A series of experiments showing the effect of the presence of molasses on the rate of solution of iron wire by sulphuric acid is also described.

Information relating to the Cultivation and Manufacture of Sugar in France. *E. Saillard. Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France, No. 1832.*

This is an important summary of information relating to the present position of the French beet sugar industry in general. It gives data relating to hectarage planted, yield per hectare, and factory rendement, which in 1922-23 was 12·26 per cent. Cost data figures are discussed in detail. Of the total cost of a quintal of sugar produced, 88·15 frs. is due to raw materials, 11·30 to coal, and 8·43 to labour. Then particulars of the type of plant used and processes followed are given. Most factories add milk-of-lime (84), a few (6) only using dry lime. Of triple effects there are 13, quadruple 42, and quintuple and higher 38, while the factories employing systematic reheating number 75. Open crystallizers (84) are more in favour than closed (14). In regard to molasses treatment, one factory employs the Steffen process, another uses baryta, and one treats by osmose.

J. P. O.

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[1] *I.S.J.*, 1922, 220; 1923, 103.

[2] *I.S.J.*, 1922, 552.

[3] *Loc. cit.*

Review of Recent Patents.[1]

UNITED KINGDOM.

Centrifugal Separator for the Clarification of Cane Juice, etc. *Wilfred Hunt* (communication from *Sir Frank Reynolds*, of Lynton Hall, Sezela, Natal). *211,030.* March 27th, 1923.

An apparatus for separating solids from liquid consists of an imperforate conical shell A^1, carried by a flanged sleeve C^1 secured to the driving spindle C^2, and provided with a series of blocks A^2, the inner surfaces of which are inclined to the radial and also follow the conical inclination of the shell. The joints between the surfaces form gutters A^4 along which the solids pass under centrifugal force. Discharge apertures B^2 are made in the shell at the tops of the gutters, and these may be closed by rods B^4 associated with bell-crank levers and the sleeve E^2 on the extension C^4 of the driving spindle. The upper end of the shell forms an inturned lip B^1 over which the liquid is discharged. The unclarified liquid, such as cane juice, is introduced through the hollow shaft C^2 and guided to the bottom of the shell by the casing C^3. Any solid matter travels along the gutters A^4 to the discharge apertures B^2 and thence to the gutter D^3. In a modification the separator is of the suspended type; the planes bounding the blocks A^2 are inclined to the axis of the basket and the unclarified liquid is introduced into the shell through holes in the bottom plate. The surfaces in the shell may be of one inclination only, or alternate surfaces may be of opposite inclinations. The rods B^4 are moved by centrifugal force to close the apertures B^2, and they are moved to open the apertures by an upward movement of the sleeve E^2, Fig. 1. A modified form of operating gear is shown in Fig. 3. Operation of the worm and worm-wheel *63, 61* raises the rod F^4 and depresses the rod F^3. This causes the wedge E^4 to drop behind the pin E^5, and so to withdraw the rods B^4 to open the apertures B^2.

FIG.3.

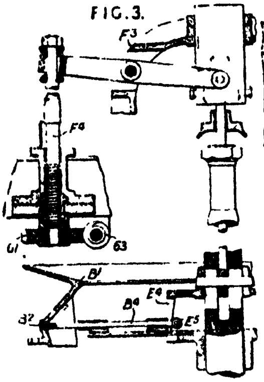


FIG.1

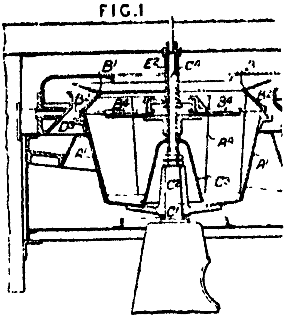
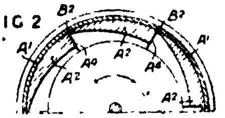


FIG 2



Confectionery Manufacture. *(A) H. Jäger,* of Copenhagen, Denmark. *211,479,* February 13th, 1924; convention date, February 14th, 1924. (*B*) *A. H. Hobson and R. S. Mitchell,* both of Sheffield. *211,557.* November 18th, 1922. (*C*) *W. T. D. Hartley* (*T. Hartley & Son,* of Bury). 211,684. February 8th, 1923.

Prevention of Incrustation and Corrosion in Evaporators, Vacuum Pans, Boilers, etc. *K. Schnetzer,* of Aussig-on-Elbe, Czecho-Slovakia *211,588,* addition to *174, 905.* November 24th, 1922.

In a modification of the invention described in the parent specification,[2] a direct current electrical installation having an earth return is utilized, the surface to be protected being connected to the conductor leading from the bus-bar to earth, or to the bus-bar itself.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

[2] *I.S.J.*, 1922, 498; 1924, 224.

Active (Decolorizing) Carbon. (*A*) ***Ges. für Chemische Produktion,*** of Mannheim, Germany. *211,886.* February 22nd, 1924; convention date, February 22nd, 1923. (*B*) ***Akt.-Ges. für Anilin-Fabrikation,*** of Berlin, Germany. *213,195.* September 25th, 1923. (*C*) ***J. Perten,*** of Prague, Czecho-Slovakia. *213,252.* March 17th, 1924.

(*A*) Active charcoal is produced by carbonizing a cellulose support, such as wood, cork waste, or straw, which has been soaked in a lye containing cellulose, such as sulphite cellulose liquor. Salts, etc., may also be added. (*B*) Active charcoal is produced together with alkali sulphides by impregnating wood or other cellulosic material with alkali bisulphate or a mixture of alkali sulphate and ammonium sulphate, carbonizing at above 500° C. and washing the product. In examples, wood is impregnated with a concentrated solution of sodium bisulphate or of sodium and ammonium sulphates. (*C*) A charcoal (particularly suitable for decolorizing red wines), is prepared by carbonizing organic substances, such as wood waste, charcoal, peat, cellulose, grains, brewers' grains, distillers' grains, animal waste, and spent charcoal. which have been previously impregnated with a solution containing zinc chloride and other metallic chloride, such as that of potassium, calcium, strontium, magnesium, or manganese. In an example peat, sawdust, etc., are impregnated with strong solutions of zinc and potassium chlorides, dried and carbonized, the product being washed with water, acid, and again with water, then dried and ground. (Specification 10126/14 is referred to).

Production of Fertilizer from Distillery Spent Wash (Vinasse). ***Soc. E. Coppée & Cie.,*** of Brussels, Belgium. *200,070.* May 30th, 1923; convention date, June 29th, 1922.

Distillers' wash or like organic matter is treated with sufficient sulphuric acid or acid salt to neutralize alkalies and decompose nitrogenous organic matter, a small quantity of peat, sawdust, rice straw, or similar matter is added, and the mixture is dried in a thin layer on heated drums or in an oven or furnace at a temperature not exceeding 280° C For the drying the material may be carried on a wire gauze, which is subjected to a cooling operation before removal of the material therefrom. Volatile matters given off during the drying may be recovered by washers. Sulphuric acid used in the washers may be applied in the treatment of fresh wash.

Desiccation of Beet previous to Extraction. ***I. de Vecchis,*** of 1, Corso Umberto, Rome. (*A*) *209,738.* January 8th, 1924; convention date, January 9th, 1923. (*B*) *211,113.* January 16th, 1924; convention date, February 9th, 1923.

(*A*) Beets are cut into pieces, which are dried at 90–100° C. during 3 hours. Dried pieces are thus obtained which will keep for a considerable time, and when required for the manufacture of sugar are extracted with water in the usual way. The juice is heated to 90–100° C., and a small quantity of lime added, subsequent operations being as usual. (*B*) Beet juice is treated with lime, and neutralized with monocalcium phosphate. preferably in the form of superphosphate. Powdered limestone is added, and the whole filtered. Subsequently, the juice can be decolorized with carbon, and concentrated in the usual way. The residue from the filtration may be used again in the place of the limestone till exhausted, when it is applied as manure.

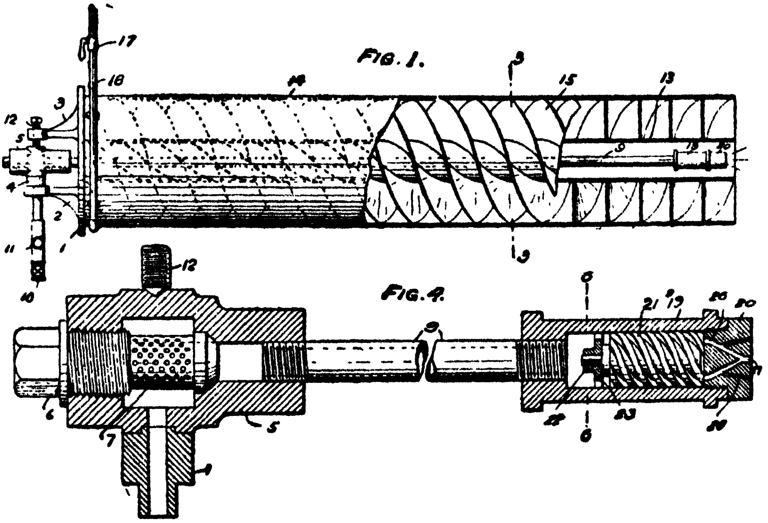
Prevention of Incrustation and Corrosion in Evaporators, Vacuum Pans, Boilers, Heaters, etc. ***E. A. Heberlein,*** of London (assignee of ***R. Bayer,*** of Schaan, near Buchs, Switzerland). *210,055.* December 11th, 1923; convention date, January 16th, 1923.

In means for protecting metallic surfaces by passing a direct current through them, the current is alternately interrupted or reduced and closed or increased. Small currents such as produced by a thermo-couple may be used. It is also stated that the source of current may be local action from the metallic surfaces to be protected; and that an induced current may be used.

UNITED STATES.

Burner for utilizing Molasses as Fuel. *Paul G. Hildebrandt* (assignor to *Blackstrap Fuel and Potash Products Co.,* of Delaware, U.S.A.) *1,476,714.* December 11th, 1923.

Referring to the drawings, it is seen that the burner is provided with an end head *1*, which is provided with brackets *2*, *3*; the bracket *2* has a head which supports a block *4*, having a central channel. On the block *4* rests a casing, which has at one end a screw-threaded opening for the reception of a screw-threaded plug *6* carrying a filter *7*. The filter comprises a perforated tubular member having a conical end which engages a conical seat *8* in the casing. The other end of the casing has a somewhat contracted threaded opening to receive the burner tube *9*. The pipe *10* from a superheater, not shown, connects with the channel in the block *4* and has a valve controlled steam inlet pipe *11*. The bracket *3* has a threaded head to receive a screw *12* engaging the filter casing *5*. The superheated molasses is carried to the filter *7*, air being blown into the pipe *10* at a point comparatively close to the filter. The molasses passing through the filter enters the burner tube *9*. Surrounding the burner tube *9* and concentric therewith are an inner cylinder *13* and an outer cylinder *14*, a spiral *15* being arranged between the two cylinders.



In front of the end head *1* is a header *16* into which air under pressure is admitted through the valve *17*. The header *16* has branches *18* communicating with the space within the spiral. The burner tube *9* terminates near the front end of the cylinder *13*, and is threaded into an opening in the casing *19* of the pulverizer. The front end of the casing *19* is closed by a nozzle *20*, back of which nozzle is a block *21* in which are formed four spiral grooves. The rear end of the block *21* carries a square shank *22*, which extends through the neck of a partition *23* secured within the casing *19*, whereby block *21* is held against rotation. The partition *23* has four peripheral recesses *25* which communicate with the space in the casing *19* at the end of the burner tube and also with the entrances to the several spiral grooves of the block *21*. The four spiral grooves communicate at their front ends with four channels *26* in the nozzle *20*, which channels merge into a common outlet *27*. Four other discharge passages *28* communicate with the respective channels *26*. The molasses from the pulverizer impelled by air entering the flowing current is sprayed into a suitable combustion chamber where it mixes with the air discharged from the cylinder *14* and ignites and burns as freely as fuel oil. The length of the burner is made necessary by the fact that, in the combustion chamber of bagasse furnaces, the point of ignition is preferably at a substantial distance from the opening of the combustion chamber. The envelope of air flowing about the burner tube *14* protects the molasses from the direct heat of the furnace, besides furnishing the air required to form the most desirable combustible mixture.

FURNACE FOR BURNING BAGASSE AND LIQUID FUEL. *Roberto Almagro*, of Habana, Cuba. *1,478,418.* December 25th, 1923.

This invention relates to furnaces which burn bagasse and a liquid fuel (such as petroleum) in different fire-places, and has for its principal object to provide a furnace of such construction allowing the most thorough cleaning of the furnace, greater and more uniform heating of the boilers, and conditions favourable to the preservation of the same. In the figures there is represented a furnace *A* of a cubical shape within which two boilers *1* and *2* are mounted and which is provided at its front part with three fire-places; a central fire-place *3* for burning bagasse and two fire-places *4* and *5* for burning petroleum on opposite sides of the first, and the three in an advanced position with relation to the body of the furnace *A* which contain the boilers. The fire-place for burning bagasse as is usual has its hopper *31* for feeding bagasse, grates *6*, ash pit *7*, damper door *8'* to fire-place, damper door *8* for the ash pit and, above the damper door *8'*, an aperture *9* with its door for feeding wood to the fire-place *3*. The rear wall *10* of the fire-place is inclined (as is seen in Fig. 2) in order to facilitate the leading of the burning gases towards the outside of the fire-place. The fire-places *4* and *5* for burning petroleum are also provided with their liquid fuel burners *11* and *12*, ventilation holes *13* and *14* and dampers *15* and *16*. As is shown by Figs. 2 and 3, the fire-places *3*, *4* and *5* slightly extend inwards of the body of the furnace constituting the rear part of the casings of fire-places *4* and *5* rests for the front part of the boilers *1* and *2*, those therefore remaining free of direct contact with the fire-places. Behind the fire-places *4* and *5* there are ash pits *4'* and *5'* to which gases proceeding from the fire-place *3* for burning bagasse have access through passways *27'* formed between the lateral walls of fire-place *3* and an extension *27* of partition *26'* which separates boilers *1* and *2*; the extension *27* separates ash pits *4'* and *5'*. A small vault *3'''* covers the space which exists behind fire-place *3*, being a continuation of cover *3''* of said fire-place and extending up to the projection *27*; therefore the burning gases proceeding from the fire-place *3* and gathered up under the small vault *3'''* are distributed and forced towards ash-pits *4'* and *5'* through passways *27'*, the bevelled outline of the end or head of projection *27* facilitating this circulation, which then continues over the fire bridges *22* underneath, which there is formed a tunnel *23* transverse to the furnace, the ends of which open to both

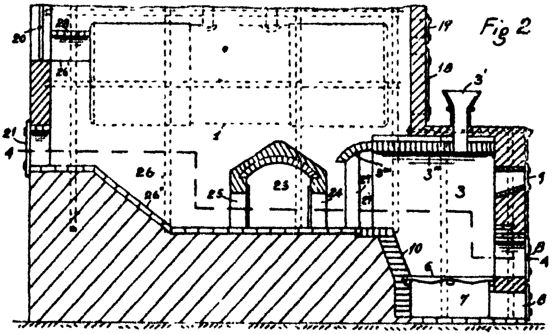


Fig 2

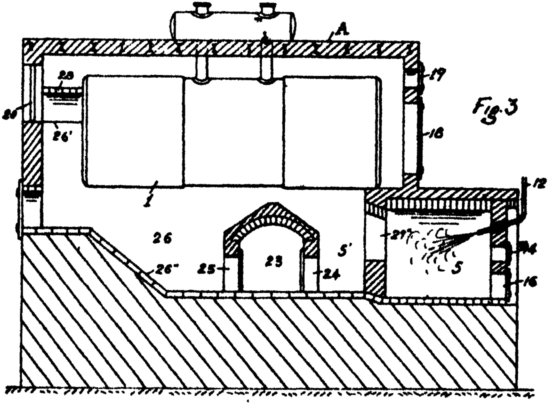
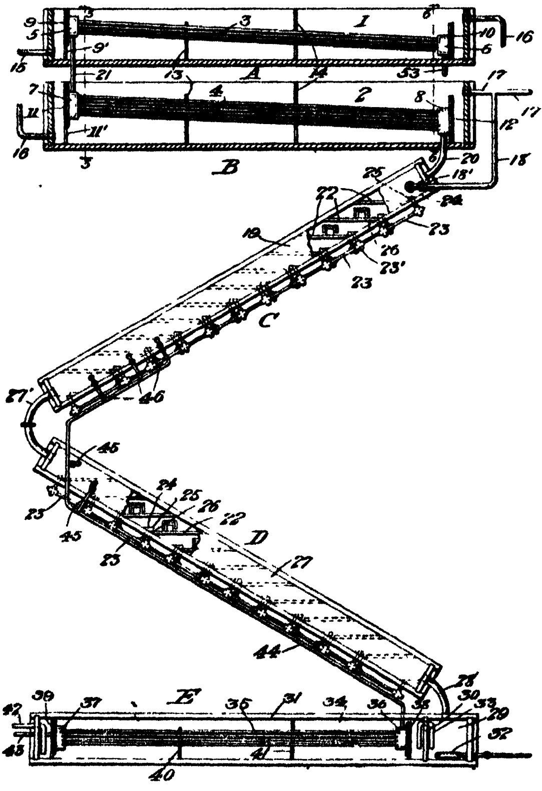


Fig. 3

sides of same. Said tunnel is provided on one side with doors *24* for inspection and cleaning of the ash-pits behind fire-places *3*, *4* and *5* and on the other side with doors *25* for inspection and cleaning of the rear smoke passages underneath boilers *1* and *2* to which access is also had through the doors *21*, the floor of said passages being inclined or sloping as shown by *26'* to facilitate the better collection of the residues or waste of burning. Lastly, as is shown by *28*, the invention provides, back of the boilers *1* and *2*, a continuous vault, which forms a buffer plate preventing the burning gases from circulating upwards, but forcing them towards the front of the furnace through the fire flues of boilers *1* and *2*.

CONTINUOUS DISTILLING APPARATUS. *J. P. Foster and A. F. Misener*, of Paia, T.H. *1,466,221*. August 28th, 1923.

It comprises five sections, viz., *A*, the condenser ; *B*, the doubler ; *C* and *D*, the distilling columns proper ; and *E*, the heater for the "beer" to be distilled. The condenser *A* is preferably arranged directly above the doubler *B*, which condenser and doubler comprise troughs or housings *1* and *2* having mounted therein a series of tubes *3* and *4* slightly inclined, connected at their ends by header sections *5* and *6*, and *7* and *8*. These series of tubes *3* and *4* of the condenser *A* and doubler *B*, respectively, are also supported by intermediate partitions *13* and *14*. The end partitions *9* and *11*, supporting the elevated ends of the tubes *3* and *4*, are provided with openings *9'* and *11'* to permit the passage of the cooling fluid admitted within the housings *1* and *2* of the condenser and doubler for the purpose to be described. The partitions *13* allow for the fluid passing over the top thereof and that the partitions *14* are somewhat similarly constructed to the partitions *9* and *11*, to permit the cooling fluid to flow beneath said partitions. The cross-partitions *10* and *12*, supporting the header sections *6* and *8* of the depressed ends of the tubes *3* and *4*, do not extend to the top edge of the troughs or housings *1* and *2*, in order to permit the cooling fluid to pass up and over said partitions *10* and *12*. With this construction of cross-partitions, it will be noted that as the cooling fluid first enters the condenser *A* by the pipe *15* it will be caused to flow under the partition *9*, over the partition *13*, under the partition *14*, and over the lower end partition *10*, thereby causing a continuous circulation of the fluid around and through the tubes *3*. The fluid will continue to rise in trough *1* until it reaches the level of the pipe *16*, whereupon it will pass through pipe *16* into the bottom portion of the trough *2*, housing the doubler *B*, whereupon said fluid will be conducted through said doubler *B* in a manner similar to its course through the condenser *A*.



The fluid will continue to flow into the trough *2* of the doubler *B* until it reaches the level of pipe *17* after which said fluid will be conducted over to the waste by pipe *17'* or by way of the by-pass *18* through a regulating valve *18'* into the upper end of distilling column *19* of section *C* of the apparatus. The upper end of the distilling column *19* is also in communication with the lower end of the tubes *4* of the doubler *B* by way of a series of pipes *20*, the upper end of the tubes *4* of said doubler being also in communication, by way of a series of pipes *21*, with the upper end of the tubes *3* of the condenser *A*.

The distilling column *19* is preferably inclined and provided with horizontally disposed partitions *22* forming a series of chambers. These chambers are connected by a series of exteriorly arranged pipes *23*, the inlet ends *24* of said pipes being slightly elevated above the level of the partitions *22* and mounted in cross-bars or blocks *25*, which bars or blocks establish the liquid level in each chamber The lower or outlet ends *26* of the pipe *23* are on the same level with the partitions *22*, for the purpose to be hereinafter more fully described, this same arrangement being carried out through the length of the distilling column *19* from chamber to chamber, forming a continuous down-pipe arrangement for the downwardly flowing liquid. These down-pipes *23* are furnished with 4-way fittings, which not only provide the proper connexions for the entrance and exit sections of the down-pipes *23*, but also form a simple and ready means of cleaning these pipes by removing the screw plugs in the fittings *23'*. Disposed below the distilling column *19* of section *C* is another similarly constructed distilling column *27*, comprising section *D*, said column *27* being connected to column *19* by a series of pipes *27'*, through which the liquid flows from the column *19* into the column *27*, passing through said column and finally reaching the lower end of column *27*, where it is discharged by a series of pipes *28* into the heating chamber *29* formed by a partition *30* arranged within a housing *31*, and comprising the section *E*, which is here referred to as the "beer-heater." By inclining the main distilling columns *19* and *27*, a greater horizontal area of the various chambers is obtained than would be possible with distilling columns of the same cross-section vertically disposed, giving a greater capacity in proportion to its cross-section, which capacity, to a great extent, governs the bubbling area of the vapour caps. Another great advantage in inclining these main distilling columns is that the upper sides thereof can be very conveniently made removable, either in whole or in part, whereby instant access may be had to the interior of the still without disturbing any other part of the distilling column.

PRODUCTION OF ADSORBENT (DECOLORIZING) CARBON. ***Jacque C. Morrell***, of Chicago, Ill., U.S.A. *1,478,985-1,478,987*. December 25th, 1923.

Claim 1: In a process of making built-up structural adsorbent charcoal, heating a mixture of carbon with a non-fluid binder which chars on heating and the softening point of the binder, moulding the mixture under substantial pressure, charring the binding material therein and activating by heating.

PRODUCTION OF DECOLORIZING CARBON. ***Rod A. Demme*** (assignor to ***Darco Corporation***, of New York, U.S.A.). *1,479,851*. January 8th, 1924.

Claim 1: The process of making a decolorizing material which comprises destructively distilling oil shale to remove as much as possible of the volatile material, "cleaning out the pores of the so-distilled shale at a temperature ranging above 600°C.," and removing impurities with weak acid.

BEET STORE. ***Henry G. Schwarz***, of Denver, Colo., U.S.A. *1,478,634*. December 25th, 1923. BEET DIGGER AND CONVEYOR. ***Alva M. Ricks***, of Los Angeles, Colo., U.S.A. *1,479,929*. January 8th, 1924. BEET HARVESTER. ***William H. Kopitke*** (assignor to ***American Beet Harvester Co.***, of Toledo, Ohio, U.S.A.). *1,480,270*. January 8th, 1924. BEET CUTTER. ***Herman L. Hartburg***, of Denver, Colo., U.S.A. *1,483,803*. February 12th, 1924.

The late GEORGE A. LOCKETT, of the firm of Wm. & Jno. Lockett, London, Liverpool, Lima and Callao, Peru, left £503,938.

Sugar Crops of the World.

(Willett & Gray's Estimates to May 22nd, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
United States—Louisiana	Oct.-Jan.	144,664	263,478	289,669
Texas	,, ,,	2,500	2,875	2,920
Porto Rico	Jan.-June	363,146	338,456	362,442
Hawaiian Islands	Nov.-July	571,800	479,463	502,194
West Indies—Virgin Islands	Jan.-June	2,000	1,739	5,000
Cuba	Dec.-June	3,900,000	3,602,910	3,996,387
British West Indies—Trinidad	Jan -June	55,000	41,619	59,948
Barbados	,, ,,	45,000	52,715	36,742
Jamaica	,, ,,	33,000	33,029	42,167
Antigua	Feb.-July	8,500	12,642	9,850
St. Kitts	Feb.-Aug.	10,000	10,735	8,426
Other British West Indies	Jan.-June	8,000	5,292	9,238
French West Indies—Martinique	Jan.-July	17,000	19,700	18,329
Guadeloupe	,, ,,	25,000	25,043	22,393
San Domingo	Jan.-June	200,000	184,171	225,000
Haiti	Dec.-June	10,000	10,967	12,283
Mexico	,, ,,	135,000	130,763	119,800
Central America—Guatemala	Jan.-June	22,000	24,445	19,090
Other Central America	,, ,,	56,000	50,336	55,990
South America—				
Demerara	Oct.-Dec. and May-June	95,494	101,128	107,797
Surinam	Oct.-Jan.	10,000	11,719	10,931
Venezuela	Oct.-June	18,500	16,000	16,000
Ecuador	Oct.-Feb.	17,000	14,220	13,318
Peru	Jan.-Dec.	275,000	313,743	319,864
Argentina	May-Nov.	257,349	209,718	172,236
Brazil	Oct.-Feb.	425,000	595,723	491,933
Total in America		6,706,953	6,552,629	6,929,947
Asia—British India	Dec.-May	3,266,000	3,044,000	2,532,500
Java (1924-25: 1,802,000)	May-Nov.	1,771,772	1,746,875	1,649,610
Formosa and Japan	Nov.-June	450,000	405,800	406,966
Philippine Islands	,, ,,	323,000	264,000	338,160
Total in Asia		5,810,772	5,460,675	4,927,236
Australia	June-Nov.	281,859	306,678	299,465
Fiji Islands	,, ,,	35,000	40,000	71,731
Total in Australia and Polynesia		316,859	346,678	371,196
Africa—Egypt	Jan.-June	100,000	94,554	108,963
Mauritius	Aug.-Jan.	203,000	231,190	197,420
Réunion	,, ,,	50,000	40,000	55,564
Natal	May-Oct.	180,463	158,221	155,194
Mozambique	,, ,,	60,000	45,950	34,446
Total in Africa		593,463	569,915	551,587
Europe—Spain	Dec.-June	12,000	13,918	13,805
Total cane sugar crops		13,440,047	12,943,815	12,793,771
Europe—Beet sugar crops		5,009,631	4,514,322	3,973,100
United States—Beet sugar crop	July-Jan.	787,217	615,936	911,190
Canada—Beet sugar crop	Oct.-Dec.	16,500	12,400	18,931
Total beet sugar crops		5,813,348	5,142,658	4,903,221
Grand total Cane and Beet Sugar	Tons	19,253,395	18,086,473	17,696,992
Estimated increase in the world's production	,,	1,166,922	389,481	934,000

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to May 29th	1,486,371	1,609,232
Deliveries ,, ,,	1,433,372	1,594,822
Meltings by Refiners ,, ,,	1,305,710	1,433,630
Exports of Refined ,, ,,	72,000	107,000
Importers' Stocks, May 29th	53,793	14,410
Total Stocks, May 29th	200,694	182,191
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons.	1923-24 Tons
Exports	1,310,571	1,912,392	1,891,350
Stocks	997,291	756,155	940,715
	2,307,862	2,668,547	2,832,065
Local Consumption	50,000	40,000	40,000
Receipts at Port to March 31st	2,357,862	2,708,547	2,872,065

Havana, April 30th, 1924 J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to May 22nd, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
Germany	Sept.-Jan.	1,125,000	1,463,000	1,305,810
Czecho-Slovakia	Sept.-Jan.	1,030,000	733,825	659,907
Austria	Sept.-Jan.	48,000	23,976	16,322
Hungary	Sept.-Jan.	125,000	81,603	74,898
France	Sept.-Jan.	495,000	490,360	306,073
Belgium	Sept.-Jan.	300,000	268,928	289,866
Holland	Sept.-Jan.	232,000	255,592	379,770
Russia (Ukraine, etc.)	Sept.-Jan.	346,625	193,400	49,374
Poland	Sept.-Jan.	378,600	294,269	179,096
Sweden	Sept.-Jan.	153,890	71,790	231,066
Denmark	Sept.-Jan.	109,000	88,382	146,800
Italy	Sept.-Jan.	311,450	261,607	217,532
Spain	Sept.-Jan.	175,000	160,035	72,257
Switzerland	Sept.-Jan.	5,500	6,033	5,856
Bulgaria	Sept.-Jan.	26,566	16,250	12,712
Roumania	Sept.-Jan.	80,000	49,872	25,761
Other Countries	Sept.-Jan.	68,000	55,400	—
Total in Europe		5,009,631	4,514,322	3,973,100

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th May, 1924.

The market has again continued its downward path during the period under review, and generally prices are 4s. to 6s. per cwt. lower.

The terminal market—in spite of one or two reactions—has been a weak and declining one. Speculators continued to transfer their May to August and some even realized their commitments in May at best possible. The premium on May of 2s. 6d. per cwt. ran off during the month until May and August were quoted at the same price. About 7000 tons were tendered in May, and the anxiety of holders to get rid of this sugar added further to the weakness of the technical position. May sold from 26s. to 21s. 6d. to 22s. 6d., June from 25s. to 21s. to 22s., August fell from 24s. 6d. to 22s. 9d., recovering to 24s. 9d., then relapsing to 20s. 9d., and finally steadying round 22s. New crop has had moderate fluctuations but on the whole has continued to fall. October/December sold from 22s. to 20s. to 20s. 6d., while December declined from 21s. 6d. to 19s. 4½d. the lowest point and then rose to 20s. The latest prices are June 21s. 9d., August 21s. 6d., October/December 20s., and December 19s. 7½d.

Trading in actual sugars has on the whole been very poor. Buyers have been very reserved in their attitude as is usually the case on such flat markets. The deliveries of sugar have naturally improved since the Budget but generally speaking very little fresh business has been entered into as the trade are acting with extreme caution and do not care to buy freely until they can see some prospect of stabilized markets.

The British refiners made a good many alterations in their prices. On 11th May they were reduced 1s., on 13th May a further reduction of 1s. took place, on 15th May a further 1s., on 19th May they advanced 6d., on 26th May they again declined 1s. The prices were again lowered 1s. on June 2nd and 1s. on June 5th, but on June 10th they were advanced 6d., making a total reduction for the month of 6s. To-day's quotations are No 1 cubes 40s. 9d., London Granulated 37s. 7½d. The refiners, in view of the poor demand from the trade, have not been active buyers of raws, only isolated transactions have taken place. Sales were made in Cuban 96 per cent. from 21s. 6d. to 17s. 6d.

Foreign Refined has been inactive and the demand has been poor. Czecho Sugars were offered on the market in fairly large quantities and declined in price from 26s. 9d. to 22s. 9d. Dutch Granulated sold from 27s. 6d. to 22s. 6d. American Granulated sold in small quantities from 27s. 6d. to 22s. 6d. c.i.f., but this sugar cannot be purchased at the present moment under 24s. c.i.f.

The feature has been the continued pressure of German Granulated which has fallen in price from 26s. 6d. to 22s. f.o.b. and has only been marketed with difficulty in very minor quantities.

The decline in White Javas has not been so marked as in other sugars. May/June shipment sold from 23s. down to 21s. and up to 21s. 9d. c.i.f., June/July at 22s. 6d. to 20s. 6d. to 21s. 6d. c.i.f. India has bought moderate quantities during the last month and a certain amount of sugar which was originally destined for the U.K. is now being diverted to the East.

The spot market has been very depressed and Fine Sugar sold from 41s. to 35s. duty paid, but the latest quotation is 36s.

The market in America has registered sensational declines and raw 96 per cent. sold from 4 cents down to 3 cents, the lowest price, but at the time of writing there are buyers at 3½ and sellers appear to have temporarily withdrawn. The Futures Market has fluctuated wildly and altogether it has fallen on an average nearly 100 points.

The Cuban crop has apparently surpassed all expectations and the present indications are that there will be a crop of at least 4,000,000 tons. The receipts at the outports are already about 150,000 tons more than last year. Messrs. Guma Meyer have again increased their estimate to 4,075,000 tons, and Mr. Himely has also increased his estimate from 3,985,000 tons to 4,050,000 tons.

The European Beet Crop appears to be progressing favourably and Mr. F. O. Licht still maintains his opinion that the average increase in the sowings is 20 per cent. On the other hand, the Factories' estimate from Germany show only 4½ per cent. increase against Mr. F. O. Licht's figure of 17½ per cent.

21, Mincing Lane,
London, E.C. 3.
16th June, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 307. JULY, 1924. Vol. XXVI.

Notes and Comments.

Imperial Preference: The Parliamentary Verdict.

The long promised discussion in the House of Commons of the Resolutions in favour of Imperial Preference which were passed at the Imperial Conference last Autumn took place on June 18th and 19th last. The Government had promised some months in advance that they would leave the decision to the free vote of the House. But when the day arrived, they hinted to their followers that though officially they were not opposing the resolutions, yet in their individual capacity they had decided to vote against them; as a result, only a small sprinkling of Labour men ventured to go against the judgment of their leaders. At the same time the number of Labour abstentions was unusually heavy and gives some indication of the feeling of the members in the matter. The Government having weighted the dice and being backed by the bulk of the Liberals, it was too much to expect that Preference would win the day. Actually, however, the four resolutions put, in favour of Preferences on Dried Fruits, Tobacco, Wines, and Sugar respectively, were only defeated by majorities of 6, 13, 17, and 20, with about 550 members voting. It is hence safe to conclude that if Mr. Snowden had not announced during the debate that every member of the Government would go into the Lobby against these resolutions, there would have been actual majorities for some if not all of them. But he told the House that any resolutions carried would have to be incorporated in this year's Finance Bill, and the result must be that the Labour Party and the Liberals would have to bid farewell during their Parliamentary career to any hope of seeing food taxes removed; hence it is not surprising that a number of Labour members hesitated to give vote to their better judgment lest they damaged the prospects of their Government.

While the defeat of the Imperial Conference Resolutions is thus accomplished for the time being, and the Budget Resolutions are confirmed without modification, there is a small measure of consolation in the fact that this rejection of trade arrangements with the Dominions and Colonies was only accomplished by very small majorities; and since there was evident in the House of Commons a widespread feeling of goodwill towards strengthening the bonds of union with these overseas parts of the Empire, it is fair to conclude that opinion in this country is veering round to a view of Imperial reciprocity which the free trade pedants of the Labour Government will not indefinitely be able to withstand. Indeed, we venture to believe that but for the influence of that arch-pedant, Mr. SNOWDEN, who was bent on preserving his free trade Budget policy unimpaired, the Government might have been less unanimous in opposing what a very considerable proportion of their followers regarded with a more or less friendly eye. Imperial Preference has certainly suffered a setback for the time being, and the sugar industry in particular will have cause to complain at the vicissitudes they are subjected to at the hands of home politicians; but the fact remains that the setback has been less severe than was at one time feared, and the future is correspondingly less black. The chief danger lies in the possibility that before home opinion in Labour circles is fully informed in Imperial matters, the Dominions if not also the Colonies may get tired of waiting and may complete other trading arrangements in which this country will not participate, and which may form an obstacle to that ideal of free trade within the Empire, as to which Mr. BALDWIN in the debate above referred to made a strong plea.

Indeed Mr. Baldwin's speech was one of the features of the debate. His main argument was that if we were looking to a reconstituted Europe to give us increased markets for our trade, we were risking a disappointment; a reconstituted Europe would become a more formidable competitor than the old Europe, especially in the case of Germany. He therefore found himself impelled to the conviction that the only countries we could make treaties with were our own Dominions.

Referring to sugar, Mr. BALDWIN said that it was no use telling him that, in the short time this preference had been in existence, there had not yet been a fall in the price of sugar; that reduction could only come when world production caught up with world consumption. The more they helped to develop sugar-growing in the Dominions the nearer that time would come, and by checking that growth the more they would do to keep up the price of sugar. In the West Indies Cuba had made remarkable progress in sugar-growing in closest economic association with the United States of America.

The Trinidad College Principal.

We have received with some surprise the announcement that Dr. MARTIN LEAKE has been appointed Principal of the Imperial College of Tropical Agriculture in Trinidad, in place of Sir FRANCIS WATTS. Of course it was known that Sir FRANCIS would be retiring shortly, but we had hoped, in view of his long and meritorious work in the West Indies, and latterly in the foundation and development of the great Colonial Agricultural College, that the usual regulations might be rendered somewhat elastic in his case. We learn that he will settle down in the island, and trust that he may long be spared for active work in connexion with the West Indian sugar industry, to whose prosperity he has so signally contributed. He will also have the satisfaction of watching the development of his latest creation, which we trust will be increasingly useful as the years pass by, under the management of his successor now appointed.

Dr. MARTIN LEAKE comes of a family of tropical agriculturists, his father having been a planter in Ceylon and for many years the Secretary of the Ceylon Planters' Association in London. He was educated at Dulwich, and later at Christ's College, Cambridge, proceeding in the usual course to his M.A. degree and later on obtaining the high distinction of a Doctor of Science in the University.

But the call to the East drew him to India, where for some years he worked on the botanical side of indigo, as Biologist to the Indigo Planters' Association and the Indigo Improvements Syndicate. On the foundation of the new Agricultural Department for India he entered the Government service as Botanist to the United Provinces, where he devoted some years to mendelian work on cottons, in which it was quickly seen that he was well fitted for research work. As is so characteristic of the tropical agricultural departments, he was not allowed to continue for long at this work and was called upon to act first as Principal of the Agricultural College and then as Director of the Agricultural Department of these Provinces, the latter of which posts he continued to fill until quite recently. While in the position of Principal, he wrote his book on "The Foundations of Indian Agriculture," which has recently reached its second edition. In this work he revealed a wide range of thought and knowledge, which we think show him to be well fitted for the post he is now called upon to fill. Although we believe that he has not devoted much time to the sugar industry, he must have come across this crop a good deal during his tenure of the Director's post; and the work on sugar in the United Provinces, mainly by Mr. G. CLARKE, is of a high character. As to the sugar work in the Imperial College, although it will suffer a severe loss in the retirement of Sir FRANCIS WATTS, we presume that it can be safely left in the competent hands of the newly appointed sugar technologist, Mr. OVERTON FUGUA BOYD.[1] We congratulate Dr. MARTIN LEAKE on his appointment, and wish him all success in the new work which lies before him.

The Trinidad Agricultural College.

In the press last month Lord MILNER made an urgent appeal to the public for funds wherewith to enable the Trinidad Agricultural College adequately to fulfil its functions as an Imperial Institution. As is known to many of our readers, this college is intended to serve all our tropical possessions, and its staff consists of well-qualified professors of entomology, mycology, bacteriology, botany, genetics, chemistry, soil science, agriculture, economics, and sugar technology.

The British Government has given the College a grant of £15,000 spread over 5 years, and the Caribbean colonies are contributing liberally to its support, assuring it of a permanent income of between £15,000 to £20,000 per year. The colony of Trinidad has provided free an ideal site of 85 acres in extent and given it a grant of £50,000. But further assistance upon a substantial scale is required to enable the college to carry out adequately its full functions. Funds are urgently needed for the completion and equipment of the new building and laboratories now in course of construction, and also to provide for the establishment of an instructional sugar factory, towards which the sugar machinery engineers of England and Scotland have contributed apparatus to the value of £20,000. The total sum required still for all these necessary purposes is £100,000, and it is hoped by those concerned that this amount may be forthcoming from such of the public as take an interest in tropical agriculture and realize how vital to our welfare is the scientific development of the natural resources of our colonies. Lord MILNER writes as head of a Committee set up at the instance of the Colonial Office with the object of raising the money. Contributions can be sent to the Colonial Bank, London, or to the London headquarters of the college at 14, Trinity Square, E.C. 3. We sincerely trust that the requisite funds will be obtained, so that this new institution (which in the opinion of Sir ARTHUR SHIPLEY, its chairman, is in its organization and range of instruction unique within the British Empire as a school of Tropical Agriculture) may be able to complete its equipment and embark on a successful career free from financial embarrassment.

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[1] As to Mr. BOYD, see page 363.

Requirements for Sugar Production.

In a recent issue of *Tropical Agriculture*, Sir FRANCIS WATTS usefully points out the fallacy of judging, as Mr. SNOWDEN did, of the effect of Preference on the West Indian sugar industry by the figures of production of the few years immediately following its imposition.

He remarks that in the case of wheatgrowing, for instance, an extension of area and output might be expected to follow speedily upon the advent of favourable circumstances. But in regard to sugars the case is entirely different, because sugar production is not merely an agricultural industry but also a manufacturing one. This manufacturing side imposes heavy restrictions in that the machinery required for sugar making is very heavy, extremely costly, and requires expensive and highly technical supervision. In the West Indies during the last 25 years the evolution from small and inefficient muscovado plants to central sugar factories of large capacities has produced profound economic changes, the result from a technical point of view being that now a ton of sugar can be produced from about 9 tons of cane, whereas with the small old-fashioned mills 13 or 14 tons were required. But this development has had the effect of making it necessary to ensure the successful operation of the larger factory over a long period of years, a condition which precludes rapid changes ; interdependence between field and factory over a long period is essential as is also a stabilized market.

The necessity of producing under modern conditions has automatically caused certain small islands like Dominica and Montserrat, which for topographical reasons are unable to adopt large-scale measures, to abandon sugar production, and in this way some 18,000 tons of sugar production has fallen out in the British West Indies. On the other hand, it must be remembered that the economic basis of production has been greatly improved and stabilized in other colonies in the Caribbean and has conferred far greater benefit than if there had been merely increased output as the result of a large and scattered acreage under cultivation. This change in the direction of efficiency has been accompanied by the expenditure of very large sums of money in British sugar machinery, and it is to a very great extent only by means of such investments that the sugar industry can expand in the British Empire.

Sir FRANCIS WATTS also points out that since sugar production varies greatly from season to season on account of varying rainfall not to mention actual drought, it is not adequate for statistical purposes to judge production over a small period of time; and careful consideration must in any case be given to climatic conditions and the possible incidence of pests and diseases. A more suitable standard than output would be perhaps the *acreage under cultivation*. But in the cultivation of sugar cane the process is perennial rather than annual, and entails contracts between planters and factory, and the whole conditions of sugar production are such that it is only by the most careful study of the circumstances underlying changes indicated by trade statistics that we can arrive at a rational explanation of their numerical significance.

Notes and Comments.

The Vindication of Coimbatore.

In the Autumn of 1921 we gave in several issues[1] of this journal a lengthy survey of the Report of the Indian Sugar Commission[2] appointed in 1919 by the Government of India to investigate the conditions of the Indian sugar industry with a view to its more efficient development and organization. This Commission made some useful recommendations, but we felt bound at the time to criticise one section of its report where it indulged in biassed, not to say unfair, strictures at the expense of Coimbatore Cane Breeding Station and made suggestions which if carried out would have greatly hampered the usefulness of this station as a centre of scientific sugar cane research for the whole of India.

For a full account of the matter we must refer our readers to our issue of December, 1921;[3] but we may repeat here what we then wrote—that an excessive amount of criticism had been directed to minor points and to matters of mainly academic interest, while the solid worth of the work actually accomplished at Coimbatore had been inadequately recognized; and that other criticism seemed based too much on disputing what was the desirable ideal of the station. Thus the Commission made "a most material criticism" of the policy of the Coimbatore officials in endeavouring to discover new and improved varieties capable of withstanding the rough treatment of the ryots and stigmatized it as a chimera, on the alleged ground that the ryots in whose hands these canes would eventually come were incapable of giving them the necessary rational cultivation. Altogether, the report as regards Coimbatore was of too carping a nature to appear impartial and seemed to be more bent on throwing cold water on Dr. Barber's long and painstaking efforts during the previous twenty years to develop the scientific side of sugar cultivation in India, than on supplying any constructive criticism that would enable that work to be pursued with greater advantage.

But now some two years later comes the vindication of the Coimbatore work. The Board of Agriculture in India, with a view to giving effect to the resolutions of the above Indian Sugar Commission with special reference to Coimbatore, appointed a strong Committee of its own which has thoroughly examined the views of the Commission and has lately reported to the Board. At a meeting of the Board last January the report of its Committee was unanimously approved by the main body. Since it may be taken to reflect the considered opinions of experts in India as to the findings of the Indian Commission, it is significant to note that it disagreed with the view of the latter that it was not advisable for Coimbatore to raise improved seedlings which could be safely trusted to the cultivator; it thought, on the contrary, that this aim should be encouraged. It also disputed the view of the Commission that the Coimbatore station should likewise become a research station for Madras cane work. Instead, the Committee advised strongly that the Cane Breeding Station and the post of Sugar Cane Expert should be made permanent, and, what is more, should be transferred to Imperial control, which means it should be able to work under the ægis of the Indian Government in the cause of the whole Indian sugar industry, and not remain a provincial affair. Further points dealt with by this Committee will be found on another page[4] where a fuller account of the findings is given. It suffices here to note that those findings of the Commission to which we took strong exception two years ago are just the ones which the Board's Committee now disagrees with, and as to which it advises the Board to act otherwise. The policy of the original Cane Sugar Expert, Dr. C. A. **BARBER**, is thus fully vindicated, and it may be taken for granted that, providing the funds are available from the Indian Treasury, his work will now be placed on a permanent footing, and Coimbatore under Mr. **VENKATRAMAN** will serve as a centre of research for the whole of India.

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[1] *I.S.J.* 1921, 425, 489, 554, 664.

[2] Its proper title was "Indian Sugar Committee" but in view of what is written below we use the word "Commission" to facilitate identification.

[3] *Ibid.*, p. 657. [4] p. 378.

Since the Indian Commission issued its report, remarkable accounts of the success of the Coimbatore seedlings in northern India have come to hand, and some of the information has been given in our pages, while we hope before very long to be able to publish figures of milling results that are very striking. The personnel of the Committee were well aware of this success of Coimbatore seedlings, and no doubt it strengthened them in their resolve to do full if tardy justice to the Station from which these canes had emanated. Doubtless for this reason, too, the meeting of the Board decided that a copy of the Report of their Committee which they had adopted unanimously should be sent to Dr. **BARBER**.

A New Jamaica Sugar Company.

The attempt, first announced last Autumn, on the part of a strong Scottish syndicate to develop sugar estates in the St. Thomas district of Jamaica and to erect there a 10,000 ton modern sugar factory, has met with sufficient preliminary success to warrant the directors of the syndicate floating a public company, "Jamaica Sugar Estates, Limited." The prospectus issued to the public at the end of June indicated a share capital of £400,000, divided into shares of £1 each, of which sum the directors and their friends have underwritten one-half while agreeing to apply firm for £60,000. In addition to the capital to be secured by this issue, a loan of £115,000 is being guaranteed by H.M. Treasury under the Trades Facilities Acts, while the Jamaican Government is also conditionally authorizing a grant in aid of interest on all capital expenditure in Jamaica for five years.

In the course of the last nine months the syndicate have arranged the purchase of certain estates in the St. Thomas district of Jamaica of a total acreage of about 8665 at a cost of £120,222 17s. 8d., giving an average of £13 17s. 6d. per acre. Included with these estates are live and dead stock, dwelling-houses, and a 2000-ton modern sugar factory in operation. They have, moreover, contracted for the construction and the erection complete in Jamaica of a 10,000-ton sugar factory at a cost of £134,000, specially designed for enlargement to 20,000 tons when considered advisable. Arrangements have been made with the United Fruit Company of America, who operate large adjacent estates in Jamaica, as regards transport facilities over their railways, wharfage facilities at their deep-water quay at Bowden, Port Morant, and as regards mutual exchange of cultivation rights over lands adapted to fruit and cane growing respectively. Mr. **FRANK GARNETT**, who was until recently Manager of Central Porvenir, Santo Domingo, and formerly Manager of Jatibonico, Cuba, has been appointed General Manager in Jamaica.

The directors of the new company which takes over the business of the Jamaica Sugar Syndicate, Ltd., the pioneer company formed last September, consists of **LORD INVERNAIRN** (Chairman), the **DUKE OF ATHOLL**, Sir **FREDERICK L. MACLEOD**, Commander **H. S. M. HARRISON-WALLACE**, R.N., Mr. **CHARLES DONALDSON**, Mr. **J. B. TALBOT-CROSBIE**, Mr. **J. REID KERR** and Mr. **HUGH McLEAN**. **LORD INVERNAIRN** is the head of William Beardmore & Co., Ltd.; Mr. **CHARLES DONALDSON** is head of the Donaldson Line; Mr. **TALBOT-CROSBIE** is the Managing Director of Duncan Stewart & Co., Ltd., Glasgow; and Mr. **Kerr** is the Managing Director of the Globe Sugar Refining Co., Ltd. The new company thus starts with an efficient directorate. It is proposed to manufacture 96° raw sugar and, we presume, to send this to the Greenock refineries. It may be assumed also that Messrs. **Duncan Stewart** & Co., Limited, will be supplying the necessary sugar machinery for the new factory.

The Situation in Cuba.

According to American consular advices, the commercial situation in Cuba has improved decidedly the last few weeks. The so-called revolution was effectively checked by the Government by the end of the first week in May. This revolution caused uncertainty in commercial circles in the interior of the island for a period not exceeding two weeks, but had practically no effect upon the Havana trade; there being little or no slackening in the demand for food products or for equipment for the sugar mills and plantations. This being the buying season in the latter line, good business activity has been reported by practically all purveyors.

The abundant rainfall in early May has ensured a good start for all stubble cane and for the seed cane planted since March, and the first prospects towards the 1924-25 crop with normal weather are quite favourable. As yet there has been no evidence of sudden and serious disaster from Mosaic so far as the Cuban cane crop is concerned.

The current crop, according to Willett & Gray, had attained on June 25th the record total of 4,020,774 tons, with six centrals still grinding. Himely's estimate for the total crop was 4,050,000 tons, so his figure seems likely to be attained, if not that of Guma & Mejer who have forecasted 4,075,000 tons.

Home Grown Sugar.

Sir **Ernest Jardine**, Bart., presiding at the Fourth Annual General Meeting of Home Grown Sugar Limited held on June 25th, stated that the results for the past season had enabled the Company to repay 2½ years' arrears of interest upon the Government Mortgage and to repay part of the new Mortgage raised for the alterations and extensions to the factory; also to pay a dividend of 5 per cent. on the public Share Capital without calling upon the Government guarantee of dividend. In consequence of the failure to secure the necessary new capital the amalgamation with the English Beet Sugar Corporation Limited could not be carried out, consequently the working agreement with that Company had been extended for a further three years on favourable terms.

He further stated that the recent reduction of 14s. in the sugar duty will have a serious effect upon the future prospects of the Company and upon the farmers' price for beet, but as the matter is under the consideration of the Government the Directors suggested that it was not wise to make further comment at that stage. At no time had the industry claimed the maintenance of high duties upon sugar if for revenue purposes they could properly be reduced, but the possibilities and position of a promising new industry which was of great benefit to British agriculture should not be overlooked. The shareholders had made great sacrifices to establish this new industry.

Erratum:—In a paragraph on page 328 of our June issue referring to the isomerism of urea, "ammonium carbonate" should of course be "ammonium carbamate."

It has at length been decided to start a sugar experiment station in Natal in order to take up cane breeding and to tackle some of the cane pests which are affecting the Natal cane crop.

Fifty Years Ago.

From the "Sugar Cane," July, 1874.

PROSPER LAGRANGE gave in this issue of our predecessor further details of his process for the purification of juices by means of baryta and phosphate of ammonia, of which some particulars were recently recalled.[1] He pointed out that the ordinary carbonatation process was far from perfect in eliminating impurities, "leaving as it does a large quantity of foreign matters, hurtful to the crystallization, but also giving to the organic acids a base to form salts which the carbonic acid cannot decompose." On the other hand, by the use of baryta it was claimed that it decomposed the alkali sulphates and also possessed a "very remarkable affinity for vegetable acids"; while the phosphate of ammonia precipitated the lime, barium sulphate and carbonate and calcium phosphate thus being precipitated. In the operation of the process, syrup from the evaporators, heated to 80-90° C., was treated with barium sucrate in the form of milk in suitable quantity as indicated by a preliminary laboratory syrup. Following this, a solution of the ammonium phosphate was added, also in determined quantity according to the calcium salts present in the product under treatment, the syrup being then passed through Taylor filter bags, and subsequently worked as usual. As the result of the application of this process (stated to have been in successful operation in several factories and refineries in France), the second and third sugars crystallized with great ease, giving a better yield than ordinarily owing to the elimination of a large part of the mineral salts, the whole of the lime salts, and a quantity of the organic matter.

A second paper, this time by Dr. C. SCHEIBLER, the well-known chemist, dealt with the value of phosphoric acid for the removal of lime in the refining of sugar. He had observed in the case of a beet molasses, which had stood for a considerable time, and which no longer deposited sugar, that a further crystallization resulted after the calcium had been eliminated by the addition of phosphoric acid and the molasses concentrated to its original density. He remarked that "the presence of 0·4 grm. of lime in the molasses prevents the crystallization of 13·85 grms. of pure sugar, or 34·6 times its weight," and added that "we are by no means justified in attributing to the lime alone this melassimetric coefficient of 34·6, since, not the lime alone, but the organic salts of lime, are molasses-formers. These acids when set free by the phosphoric acid added, neutralize the free and carbonated alkalies, and thus diminish their molasses-forming power." SCHEIBLER had noticed that "the action of the phosphoric is not so simple as at first appears, for the phosphoric acid in the precipitate formed is never combined with three equivalents of lime, but appears to be saturated in part by an organic nitrogenous basic combination." Thus, according to modern theory, the tricalcium phosphate had adsorbed a quantity of the organic matter, including probably some of the colouring substances, and this observation of the important effect indicated must have been among the earliest made in the sugar industry.

F. FISCHER, of Mulheim, Germany, has worked out and patented a process of making methyl alcohol for use as a motor fuel from carbon monoxide by reduction in the presence of a catalyst under pressure, formaldehyde probably being formed intermediately. It has been given the name of "Synthol," and a mixture of it and benzol in equal volumes is stated to have given very satisfactory motor trials.

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[1] *I.S.J.*, 1924, 294.

The Wembley Exhibition.

The Colonial Sugar Display.

We dealt in a previous issue[1] with the display of sugar machinery and accessories to be found at the British Empire Exhibition at Wembley. We now give below our impressions of a survey of the exhibits of sugar or its accessories staged by the several Dominions and Colonies of the Empire which go in for sugar production. Taken as a whole it is a very good exhibition of this branch of our tropical agriculture and will serve usefully to direct the attention of the home consumer to the potentialities of the Empire as a source of supply of one of our staple foods. A mead of praise is perhaps specially due to Mauritius for the scientific interest of its somewhat congested display—it was worthy of more space than had been allotted it; while the South African exhibit of sugars was very well staged for the critic to judge of the good quality of its various assortments.

Mauritius.—The Mauritius exhibit is of special interest by reason of the presence of 12 painted wooden panels, the work, we understand, of Madame P. DE SORNAY, illustrating in their natural colours about 48 canes known to Mauritius planters.[2] These are all named and are of the type of illustration made familiar by the coloured canes in Noel Deerr's "Cane Sugar." As for the sugars on view, samples of *vesou* from some of the best known Mauritius factories are exhibited in glass jars, these being mostly white, fine-grained crystals; some of them are of excellent appearance, notably those from the St. Aubin, Bel Air, Highlands, and Plaisance estates. A series of jars also contain, preserved in spirit, specimen fragments of leading canes, as well as of abnormal growths. One of the latter shows a cane with a node about 5 ins. in diameter. The Division of Sugar Technology of the Department of Agriculture in Mauritius is responsible for staging a collection of 18 glass tubes illustrating the different stages in the manufacture of Plantation White Sugar, from a section of the cut cane to the finished sugar and rum; these naturally showing the juice and syrup at their different stages of treatment, including syrup for the pan after treatment with phosphoric acid, this being particularly light in colour. Then there are samples of rum from the Namking distillery. Besides the manufacturing side, there is a small but instructive entomological collection in cases. We are shown *inter alia* the Scolia wasp larva attached to the abdomen of an Oryctes beetle larva, also a Typhia parasite on a Phytalus larva. Both the Oroctes and Phytalus pests are shown in their various stages. Altogether, the Mauritius exhibit is excellent, and shows evidence of being carefully prepared.

Natal.—The South African Sugar Industry has decidedly the best display of sugar samples of any of the colonies. These are in glass bowls inside a well lighted glass case and are easy to inspect while being kept clean and uncontaminated. They are also satisfactorily described. They include Yellow Crystals; Double Carbonatated, medium and fine Grain; Centrifugals; Mill Whites of fine and medium Grain; Refined Whites; and Castor sugar. The double carbonatation sugars are both good, the fine-grained sample having a particularly fine appearance, almost equal indeed to the South African refined exhibited near it.

In addition to the collection of sugars, this stand of the South African Sugar Association contains a number of photographs illustrating the Natal canefields. Then there are samples of "Natalite," ether, fusel oil, methylated spirits, and of absolute alcohol, all made by the NATAL CANE BY-PRODUCTS Co., also specimens of cane wax, hard and soft.

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[1] Page 243.

[2] These came on loan from the Imperial Institute, where they have been for the last few years.

British Guiana.—The British Guiana Sugar section is, it must be said, less satisfactory from a visitor's point of view. Spectacular effect is apparently aimed at, so the sugar display consists of a huge pyramidal bank covered with three grades of Demerara sugar (yellow and brown crystals, and rather inferior white) exposed to the atmosphere and the dust. The grades are not labelled; and four tubs of growing canes which flank the mass are also without any identifying label as to the variety of cane shown. There is exhibited a small model of a 5-roller cane mill, made in 1884 by Messrs. W. & A. McONIE, of Glasgow (predecessors of the Harvey Engineering Co., Ltd.) for the "Vryheid's Lust" plantation. This, it is rather interesting to note, had two preliminary rollers in the position of a Krajewski, and having deeper grooving than that on the main rolls. There is also a model of a quadruple effect evaporator supplied by Messrs. GEO. FLETCHER & Co., LTD., to Booker Bros., McConnell & Co., and one of a 2-column still made by Messrs. BLAIR, CAMPBELL & McLEAN, LTD., for the same firm.

Leeward Islands.—Antigua has a somewhat crowded display, amongst which the sugars are hardly shown to the best advantage. These are staged in small cases with glass tops or in small glass jars, but the former seem somewhat the worse for the entry of dust, while the jars are too small to allow for easy inspection. A very good specimen of Plantation White sugar is shown and there are samples also of Washed Greys and Grey crystals.

Barbados.—The Barbados section is fronted with artistically arranged groups of canes in pillar formation, but these are not labelled with the varietal name. The sugar exhibits here consist of large glass jars of "Straw" Crystals, Centrifugal Muscovado, White Crystals, etc., all well staged.

Jamaica.—The Jamaica section shows various grades of Yellow Crystals in jars but these are labelled not with their manufacturers' description but with their market classification in code word, thus losing in interest to the visitor. No white sugars are shown on this stand.

Trinidad.—Trinidad has an exhibit of sugars in bulk in glass-covered cases. These show the well-known Yellow Crystals of that island, also Dark Crystals, Syrup Sugars, and White Sugars from Usine St. Madeleine amongst others. Canes are also exhibited but not labelled. There is also staged a model of the exterior view of the experimental cane factory attached to the Imperial College of Tropical Agriculture, St. Augustine (on a scale of 4 ft. to the inch), the plant and apparatus for which has been donated by British sugar machinery manufacturers.

Australia.—The Australian exhibit of sugar is a fair-sized one, and includes exhibits in bulk under glass of the various grades of raw cane sugars, also Refined, Washed White, and Brewers' Crystals. Maffra Beet Sugar is also shown in several grades, while the process of beet sugar manufacture is exhibited (like that of cane sugar in Mauritius) by means of phials showing the juice and syrup at its various stages. A fine panoramic representation of an Australian canefield is also staged.

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The new Luabo factory of the Sena Sugar Estates Limited is expected to start operations this month. It has been designed for an initial output of 15,000 tons of sugar per crop with scope for expansion to 20,000 tons. The sugar machinery has been supplied by the Mirrlees Watson Company, Ltd., of Glasgow, and includes a 12-roller mill with Krajewski crusher, capable of grinding 60 tons of cane per hour. The electrical equipment of the factory which is very complete has been supplied by the British Thompson-Houston Co., of Rugby.

Prospects of the European Beet Sugar Crop.

(By our Continental Correspondent.)

Early this year it became increasingly certain that the European beet sowings would undergo a notable increase; how much so remained, however, an unknown factor and has not, even yet, been completely ascertained.

In most European countries the high price of sugar in recent years stimulated the zeal of farmers to go in for beet cultivation, while at the same time sugar manufacturers offered rather high prices, which were a great deal above those which might be expected from other crops. At the outset, it looked as though the area sown with beets would be much larger than in 1923, but gradually reports became less optimistic and although absolute certainty is still lacking, the table of hectares sown with beetroots given underneath for the different countries will not be far from the truth.

The spring was very late and cold, so that germination and development of the beet plants remained far behind the conditions in ordinary years. During the month of May, however, seasonable weather set in and very probably the arrears will have been recovered by now. It depends entirely on the weather during the following four months whether the crop will be a good one or not. We have assumed an average yield of beets and of sugar for the various countries, and give here a table of hectares sown and of tons of raw sugar to be expected in the different sugar-growing areas of Europe. The tons are metric ones of 2204 lbs.

Country.	Hectares Planted.	Tons of Sugar Expected.
Germany	348,549	1,250,000
Czecho-Slovakia	287,108	1,200,000
Austria	18,201	55,000
Hungary	72,698	210,000
Poland	170,000	470,000
Netherlands	71,065	280,000
Belgium	82,000	300,000
France	195,615	650,000
Italy	125,000	400,000
Switzerland	1,300	5,000
Spain	75,000	220,000
Denmark	36,857	117,000
Sweden	41,130	150,000
Bulgaria	25,000	55,000
Yugo-Slavia	52,000	65,000
Rumania	58,500	140,000
United Kingdom	10,000	30,000
Russia	310,000	545,000
Other countries	3,000	8,000
Total	1,985,020	6,150,000
In 1923-24	1,633,258	5,074,000
In 1922-23	1,364,593	4,572,430

In the first months of 1924 the expectations of an enormous increase in the beet sowings in Germany were very great; estimates of as much as 40 per cent. over last year were heard of, but later reports were much more modest. In March the estimated surplus had already come down to 20 per cent.; later on, 10 per cent. was considered to be the most probable figure, and to-day the results of the inquiry among the German sugar factories, which was answered by almost everyone concerned, produce the figure of 348,549 hectares, against 333,425 in 1923-24, which only gives an increase of 4·5 per cent.

The great difficulty in Germany is the lack of ready money felt throughout the whole country. At the time when the value of the mark dropped not only day by day, but hour by hour, everybody disposed of his earnings and holdings as soon as possible, with the result that after the stabilization of the mark no funds were available to finance a full sugar crop. Further, the permits for immigration of foreign labour, on which beet cultivation in Germany depended for a good deal before the war, are still withheld by the Government; this obviously forms a serious impediment to farmers sowing more land with beets than they can already manage to cultivate. Even taking into consideration that about 16 per cent. of the beet land has been separated from the German Empire and incorporated in Poland, Alsatia and Danzig, the German sowings have by a long way remained under the area devoted to beet-growing before the war. In the year 1923-24, 180,000 tons of sugar have been released by Government for exportation, and for the 1924-25 season a quantity of 200,000 tons has been allowed to be exported, half of which amount may be sold in the form of white and the other half in that of raw sugar.

In the last year before the war, those tracts which now form the Czecho-Slovakian Republic had sown 295,081 hectares with beets, whereas this year 287,108 hectares will be sown, subdivided as follows, with the figures for 1923-24 added for comparison.

Country.	1923/24.	1924/25
Bohemia	115,940	140,859
Moravia	71,293	94,666
Silesia	2,943	3,350
Slovakia	35,536	48,233
Total	225,712	287,108

This gives an extension of no less than 27 per cent., but as in 1923-24 the sugar content of the beets was exceptionally high in the Czecho-Slovakian Republic, it is not to be expected that the sugar crop will be larger too by that proportion, so we only estimate above a crop of 1,200,000 tons, to be on the safe side. From this crop, a sufficient quantity will be reserved for the wants of the country, while the balance is open for exportation both in the shape of raw and of white sugar, but very probably the latter assortment will be foremost in these exports.

In Austria the inquiry among the manufacturers gave as a result 18,201 hectares, against 13,010 in 1923-24 and against 10,584 in 1922-23. Though the production is increasing, yet the consumption is much more important than the home production. Large quantities will have to be imported from Czecho-Slovakia in the coming year, just as has been the case in the foregoing ones.

In Hungary the reparation of the sugar industry has made large strides. The inquiry gave as a result an area of 72,698 hectares, against 46,037 in 1923-24 and against 28,775 in 1922-23. Even in 1923-24 more sugar had been produced in Hungary than could be consumed, and for the year to come this fact will be still more the case. It is said that contracts have already been made for the sale of 50,000 tons of Hungarian sugar to Switzerland, but we do not know whether actually so large a transaction has already been made at so early a date.

In the new republic of Poland sowings are reported as being 170,000 hectares against 141,217 and 109,353 in the two preceding years respectively. This total figure is about the same as that of the sowings in the parts now constituting the Polish republic just before the war, so that Poland has reverted to its former importance as a sugar producer. Hitherto the home consumption has been greatly contingented, in order to dispose of a large amount of exportable merchandise with which to pay for imported goods, but now the restrictions for consumption are much more lenient than before; in fact, a large amount of sugar has been reserved for home consumption, while large quantities are being exported to Great Britain and to France.

The figure for the beet sowings in the NETHERLANDS is not much larger than in the foregoing seasons, and of that area a part has not been contracted for by the sugar manufacturers of Holland. Actually in recent years considerable amounts of beets grown in the Netherlands have been exported to Belgium and to Germany in order to be worked up there. In 1923-24 these exportations were equal to 50,000 tons of sugar and under such circumstances it is very difficult to forecast how much sugar will be produced in Holland from the area sown in 1924.

As a consequence of these appreciable exportations of sugar beets, the Dutch sugar production last year was just sufficient to cover the home demand, but in addition to their own sugar, large amounts of foreign raws, chiefly cane sugar, were imported and worked up in the refineries, the refined product being destined for Great Britain, France, and some other countries.

In BELGIUM too the sowings have been extended, from 59,176 hectares in 1922-23 and 72,264 in 1923-24 to about 82,000 this time. If in 1924-25 again large consignments of Dutch roots are to be worked up in Belgium, the output may exceed the 300,000 tons forecasted above, but it has to be understood that this figure stands exclusively for the sugar extracted from the roots grown in Belgium and not inclusive of the imported ones. Belgium too imports raw sugar from abroad for her refineries and ships the white sugar to various destinations, chiefly to England and France, but also to British India.

FRANCE extends her sowings considerably, having gone up from 127,450 hectares in 1922-23 and 149,848 in 1923-24 to 185,000 in 1924-25. The output of 1923-24 was bad, only amounting to 495,000 tons or a few thousand tons more than in 1922-23 when the sowings were so much smaller. It is not probable that this year the agricultural results of beet cultivation in France will be as bad as in the campaign just ended, and that is why we assume the output for 1924-25 will reach 600,000 tons refined value or even more.

France, together with her possessions and protectorates in Northern Africa consumes the equivalent of one million tons of raw sugar per annum; of that much she produces herself 650,000 tons. Meanwhile, the importance as sugar producers of the French colonies of Réunion, Martinique and Guadeloupe is decreasing to such an extent that these islands will not send more than about 40,000 tons to the metropolis, which necessitates a further importation of about 300,000 tons, raw value, from Belgium, the Netherlands, Poland, Czecho-Slovakia, Cuba, and perhaps from Java.

In ITALY we see a considerable extension of the sugar industry, which in 1922-23 occupied 85,000 hectares, in 1923-24 93,000, and now is credited with 125,000. Not less than eleven new factories will work this year, not to speak of the five others which had been active in the past and now, after having been overhauled, will also take off the crop. In the late campaign the country produced 330,000 tons of sugar and imported some 20,000 tons both from Germany and from Czecho-Slovakia; but it appears to have become overstocked, since the

Government permitted an exportation of 10,000 tons. If next campaign actually produces 400,000 tons, which is quite probable, the home consumption, which, in fact is very low in Italy, will be unable to dispose of it all. It is not certain that Italy will be able to compete on the world's market at the price level which will very likely exist in the autumn, so it is not clear where all that sugar will find an outlet.

SPAIN produced 180,000 tons in each of the two last campaigns, a total short of her needs. This year the Spanish Government is allowing the importation of 15,000 tons. For next year a production of 220,000 tons is foreseen, which will be sufficient to supply the home demand and to have something over.

DENMARK and SWEDEN do not show any great changes compared with the foregoing years. The area sown is about the same as in 1923-24 and the expected yield of the crop will be just sufficient for the consumption.

The BALKAN STATES report large increases of area sowed and it is not impossible that they may indeed produce the quantities estimated, but their influence on the general markets is so insignificant that a surplus or a deficit in those parts has only a local importance.

Neither SWITZERLAND nor GREAT BRITAIN, FINLAND nor DANZIG are in a position to influence the world's market, as regards their beet sugar production, so we refrain from commenting on the possibilities in those countries and turn our attention to Russia, which country slowly comes to the front again.

In the year 1922-23 RUSSIA produced 220,000 tons of sugar, in 1923-24 the figures ran as high as 360,000, while for 1924-25 a production of 545,000 tons is foreseen. Almost all of the factories work under Government direction, only a few of small capacity having been leased to their former owners. The crop, although much larger than in the past years, is still largely under the quantities produced before the war, so that the consumption is clearly very small, and sugar remains a very rare article of diet for the majority of the inhabitants. Some exportation to Persia and other adjacent Asiatic States is recorded, but this is to be considered as an endeavour to retain the old markets and not in the least as a sign of abundance.

Europe will need in 1924-25 about 7 million tons of sugar, raw value, and will produce herself about 6 million tons, thus leaving about one million tons to be imported from Asia, America and Africa. Part of that amount will be supplied by the French and British colonies, which enjoy preference in their respective mother-countries, while, very likely, the balance will be obtained from Peru, Brazil, Santo Domingo, Java, Cuba and the United States.

Among new companies recently registered in the U. K. is the Oliver Continuous Filter Co., of 11, Southampton Row, London, W.C.1. (incorporated in California), the capital being $500,000 in 5000 shares of $100 each.

According to a *Times* report from Nairobi, four Mauritius sugar financiers, headed by Mr. F. A. NICHOLS, have been discussing a scheme to invest £150,000 in the erection of a sugar factory near Nairobi. It has been found that in order to enable the local farmers to plant the 15,000 acres needed, they would need financing. It is therefore proposed to apply to the Government for an Empire Development loan to finance the cost of erecting the factory and equipping it with British machinery, while the Mauritius money would be used to finance the farmers, of whom some 15 have guaranteed to cultivate the necessary acreage if assisted. The capacity of the factory would be 1000 tons (? of cane) daily, and its output would serve in the first place the needs of Kenya and Uganda, hitherto mainly supplied by Java.

The Effect of Cold and of Hot Liming on the Removal of Albumin from Cane Juices.[1]

By R. G. W. FARNELL.

The writer has shown in another report[2] that protein is one of the colloids of cane juice and molasses, and that by boiling juice at natural acidity nearly 90 per cent. of this protein is coagulated. HARDIN[3] has analysed cane juice and finds the nitrogen to be distributed as follows:—

Table I.

	PER CENT.		
Nitrogen in albumin	0·0039	juice 9·75	total.
,, nuclein bodies	0·0025	,, 6·25	,,
,, albumoses	0·0021	,, 5·25	,,
,, amino acids (aspartic)	0·0122	,, 30·50	,,
,, amino acid amides (asparagine) ..	0·0098	,, 24·50	,,
,, ammonia	0·0024	,, 6·00	,,
, nitrates	0·0071	,, 17·75	,,
Total	0·0400	,, 100·00	,,

The albumin and nuclein, both of which are heat coagulable, comprise some 17 per cent. of the total nitrogenous bodies of the cane. The presence of globulin in cane juice has not been recorded in the literature as far as the writer is aware and it will be assumed for the present that the principal cane protein is albumin.

This paper is concerned with albumin and other nitrogenous substances of an ampholytic nature. The effect of these compounds in the formation of beet molasses has recently been shown by VONDRAK[4] who states that the amount of molasses produced is determined principally by the presence of the albumin which is a greater molasses-former even than the alkalies.

PROPERTIES OF ALBUMIN.

For the extensive study this substance has received in recent years we are principally indebted to PAULI, MICHAELIS, SORENSEN, ROBERTSON, and CHICK and MARTIN. While space forbids any full description of the properties of albumin, we must concern ourselves briefly with its ampholytic nature, and property of being coagulated by heat.

Albumin belongs to the class of bodies known as ampholytes which function both as acids and bases; i.e., as weak bases toward acids and as weak acids towards bases. Ampholytes are extremely sensitive toward hydrogen and hydroxyl ions and the action with acids and alkalies is complicated. Under the influence of an electric current the proteins (including albumin) migrate to anode or cathode. Very generally in alkaline solution their charge is negative, and there is a transference to the anode, while in acid solution their charge is reversed and they travel to the cathode. However, at a certain concentration of hydrogen ions (pH) the protein particles behave as if neutral and do not move in an electric field. This point is termed the "isoelectric point," and here the properties of the ampholyte show either a maximum or minimum, (i.e., minimum hydration, minimum stability, minimum viscosity, and minimum osmotic pressure, etc.).

SORENSEN finds the isoelectric point of carefully purified egg albumin to be pH 4·8. According to CHICK and MARTIN[5] the heat coagulation of albumin consists essentially of two processes: (*a*) denaturing the albumin; and (*b*) precipitation of the modified albumin. The denaturing consists of a reaction (at present imperfectly understood) between albumin and water. The precipitation of the albumin so modified occurs most readily and in maximum quantity at the isoelectric point of denatured albumin, pH 5·5 according to MICHAELIS.[1] Salts have a marked effect on the precipitation of denatured albumin at the isoelectric point. MICHAELIS and RONA[2] have found that alkaline earths exert the strongest inhibitory effect on this precipitation, alkalies being somewhat less inhibitory. Furthermore anions displace the isoelectric point to the acid side, cations to the alkaline side.

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[1] Report No 14 made to the British Empire Sugar Research Association. Here published in slightly abridged form by kind permission of the Association.

[2] For an abstract see *I.S.J.*, 1924, 333; the paper will be published *in extenso* later.

[3] HARDIN, *Louisiana Bulletin*, 91, 28.

[4] Abstracted in *Sugar*, 1923, 25, 578.

[5] *Chem. Abs.*, 1915, 9, 90.

We can now see that to ensure the maximum precipitation of albumin it is necessary to heat in slightly acid medium at pH 5·5 for pure egg-albumin. When dealing with a solution containing different ampholytes the situation is more complex. MICHAELIS however has shown[3] that in a system containing two or more ampholytes maximum precipitation occurs at a pH lying between the pH of the isoelectric points of the individual components. Furthermore, he found that the precipitate at the isoelectric point contained varying proportions of the separate constituents.

ISOELECTRIC POINTS OF THE AMPHOLYTES IN CANE JUICE.

The following are the isoelectric points of some ampholytes that are known to occur in cane juice :—

	P.H.
Denatured albumin	5·5
Aspartic acid	3·0
Asparagine	5·5
Glycine	6·1

The isoelectric point of this system, then, must lie between pH 3 and pH 6·1. At present we have no record of a determination of the isoelectric point of the ampholytes as actually present in the cane. Since it seems that the isoelectric condition of cane juice (6·5–8·3) must lie nearer the pH of raw juice (4·6–5·8) than of limed juice, we should expect more nitrogenous bodies to be precipitated by heating juice at its natural acidity before liming than by heating the juice already limed. The coagulation of the albumin by heat is irreversible, so that albumin coagulated by boiling in an acid medium is not redissolved by alkalies. Also by boiling raw juice the inhibitory effect of the alkaline earths is absent. An account follows of some experiments that have confirmed this reasoning.

EXPERIMENTAL.

Since the experiments were conducted out of the grinding season, some Uba and Bamboo canes (plant) about 11 months old were ground in a hand mill. This lightly expressed juice only contained about half the nitrogen of factory juices. But the preservation of the juice presents difficulties. If it is not preserved, albumin begins to deposit after a day; while preservation with mercuric chloride and formaldehyde are both out of the question, since the former is a capital protein precipitant, and the latter inhibits the coagulation by heat. Chloroform and toluene were used in the end, but even then protein often began to deposit after three days. It would have been more satisfactory to have used perfectly fresh mill juice, but for reasons already explained this was impossible. In all cases samples of the raw preserved juice were taken immediately before the liming experiments and the nitrogen and pH determined, also the Brix.

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[1] *J. Chem. Soc.*, 1910, 97–98, Abs. (1), 546.

[2] *Chem. Abs.*, 1919, 13, 2539.

[3] *Chem. Abs.*, 1912, 6, 1622.

Nitrogen.—Kjeldahl's method was applied: 20 c.c. of juice of known Brix were pipetted into a Kjeldahl flask, the juice gently concentrated to about 5 c.c., 15 c.c. of pure N-free sulphuric acid added, and the digestion proceeded as usual. When clear, excess of magnesia was added, and the ammonia distilled into 20 c.c. N/40 sulphuric acid. Back titration was carried out with N/40 caustic soda, using methyl red as indicator, analyses being always made in duplicate, sometimes in triplicate.

Hydrogen ion concentration.—This was performed colorimetrically using Clark and Lubs' indicators and standard buffers. Where the pH could be determined by two indicators it was done so. The pH values were accurate to ± 0·1 pH.

Brix.—This was in all cases determined by means of the refractometer.

Cold Liming Tests.

In the cold liming tests, 75 c.c. of juice were delivered from pipettes into a test-tube of about 100 c.c. capacity and the requisite amount of dilute lime cream (4° Brix) added from a pipette. The test-tube was immersed in a boiling water bath for 3 mins., removed, and gently boiled for 30 seconds over a small flame. It was then clamped in a vertical position in a large jacketted beaker of boiling water; the gas was turned off, and the tube of juice allowed to settle for 30 mins. In this way the loss of heat by radiation was very slow and the conditions approximated to those in the factory. The clarified juice was finally decanted and filtered through pleated filter paper, the filtrate then being analysed immediately as described.

Hot Liming.

In the hot liming tests, the procedure was as above, except that the lime cream was pipetted into the boiling juice. In two cases the juice was superheated to 116° in an autoclave before liming and subsiding. There did not seem to be much difference in the rates of settling of the muds from the juices limed cold and hot. This is principally a function of the pH. The volume, as well as the actual weight of the precipitate increases with the pH. The results of Deerr,[1] who was the first to give an account of the effect of adding lime on the volume and quantity of the cane-juice muds, were confirmed. The results of the cold and hot liming experiments are given below :—

Table II.

			NITROGENOUS SUBSTANCE ($N \times 6·3$)		
SERIES.	pH Raw.	Juice Clarified.	Per cent. Brix Raw Juice.	Per cent. Brix Clarified Juice	Per cent. Nitrogenous Substance removed.
I. UBA—					
Cold liming	4·6	6·8	1·01	0·99	2·0
Hot liming	4·6	7·6	1·01	0·77	23·7
II. UBA—					
Cold liming	4·6	7·0	1·08	1·01	6·5
Hot liming	4·6	7·4	1·08	0·80	26·0
III. UBA—					
Cold liming	4·5	6·4	0·92	0·87	5·4
Hot liming	4·5	6·5	0·92	0·87	5·4
IV. BAMBOO—					
Cold liming	5·8	8·2	0·60	0·48	20·0
Hot liming	5·8	8·7	0·60	0·46	23·3
116°C. liming	5·8	8·7	0·60	0·43	28·3
V. BAMBOO—					
Cold liming	5·8	7·2	0·60	0·55	8·3
Hot limimg	5·8	7·5	0·60	0·52	13·3
116°C. liming	5·8	7·7	0·60	not determined	

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[1] *I.S.J.*, 1916, 502 and 558.

DISCUSSION OF ABOVE RESULTS.

In all cases except one, hot liming precipitated more nitrogenous substance than cold liming. The actual difference varied in each case, and this can be attributed partly to the changing protein content of the juices, due to the spontaneous protein precipitation to which reference has already been made. The writer is confident that a more extended series of experiments performed in close proximity to a supply of factory mill juice would reveal consistently higher nitrogen content of juice clarified by cold liming instead of by hot liming.

The second point to be noted is the difference in the pH of the juice clarified by hot and cold liming. In each case the pH of the hot limed juice is higher (i.e., the juice is more alkaline) than the cold limed juice. In other words, less lime is required to bring a cane juice to a given pH when the lime is added to the boiling juice than to cold juice which is afterwards boiled. This has been recorded by MULLER,[1] who stated "that the lime added to the juice after superheating to 116°C. may be diminished to about one-third of the usual quantity without inconvenience." The reason for this may be that the hot limed juice is less "buffered" than the cold limed juice, owing to more protein being precipitated, less lime consequently being required to bring the juice to the same pH. Neither MULLER, nor BIRD[2] (who confirmed this statement), however, determined the pH of the juice.

In one case superheating to 116°C. before adding the lime precipitated more nitrogenous substance than adding the lime to the juice at the boil. The superior clarification of cane juices by hot liming has been recorded recently by KREULEN,[3] who limed caned juices in three different ways:—

(1) The juice was treated with calcium sucrate until slightly alkaline to litmus, then raised to the boil, boiled for 20 secs. and subsided for 35 mins. in a jacketted glass cylinder. (2) The juice was first heated to 85°C., and while still being heated the same amount of calcium sucrate added, heating was then continued to the boil. The subsequent procedure was identical with the first. (3) The juice was raised to the boil and the calcium sucrate then added, and the juice subsided as in the first test. KREULEN remarked that the juices clarified by methods (2) and (3) filtered better; and he concludes that the additional organic matter removed was of a slimy nature. No nitrogen determinations were carried out in the experiments recorded.

Recently SKOLA,[4] working on beet juices, has found that the ordinary method of liming cold eliminated 3·9 per cent. of the original nitrogen present. This figure was increased to 5·7 per cent. by adding the lime to the juice at 80°C., and by adding the lime in two successive fractions at this temperature, 6·9 per cent. of the total nitrogen could be eliminated. These results conform to the greater elimination of protein by heating the juice at natural acidity.

In order to find out the pH to which boiling cane juice should be limed in order to eliminate the maximum amount of total nitrogenous substance, the following experiment was performed:—50 c.c. of cane juice were brought to the boil in a large test tube and varying quantities of saturated lime water added, after which it was subsided in a jacketted beaker of hot water as described. After 30 mins. the test tube was removed, and the position of the muds marked, the juice being then filtered and the filtrate analysed for Brix, nitrogen, and pH. The volume occupied by the muds was found by running in water to the mark from a burette as described by **Deerr**,[1] the results obtained being given in the following table:—

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[1] *I.S.J.*, 1921, 581.
[2] *I.S.J.*, 1923, 44.
[3] *I.S.J.*, 1923, 265.
[4] *I.S.J.*, 1923, 496.

Table III.

pH Limed Juice.	Volume of Muds. c.c.	Total Nitrogen removed. Per cent.
6·9	9·4	13·9
7·6	12·7	26·4
7·8	14·6	34·3
8·8	18·0	36·8
9·4	35·4	43·4

In view of the great increase in the volume occupied by the muds at a pH over 9 it would be impossible in practice to lime to this alkalinity. In fact, liming the hot juice beyond pH 8 would not be advisable. At pH 8 (alkaline to litmus, acid to phenolphthalein) there would be a high percentage of nitrogenous substance removed; moreover, the pectin would be converted to calcium pectate, as pointed out by the writer.[2] There would be no danger of decomposition of the reducing sugars at this pH.

Actually, **Allen**[3] has advocated liming Porto Rican juices to corallin "neutrality" (about pH 7·6, while **McAllep**[4] has recently described some of the advantages noted in Hawaiian mills by increasing the liming of the cold juice to litmus alkalinity (about pH 8).

In conclusion, it may be mentioned that luckily there are wide limits of hydrogen ion concentration (from pH 6·3 to 8·5 for juices examined by the writer) between which some sort of "clarification" occurs. Owing to the strong buffering of cane juices due to proteins, amino acids and amides, weakly ionized organic acids, etc., the pH of factory clarified juices usually keeps to within 0·2 pH. There must be some radical change at the liming station to alter the pH one unit (say 0·5 pH). Considering the "control" exercised at the liming station of some factories, the buffering natural in raw cane juice is extremely fortunate.

The two sugar mills in Haiti produced during 1923, 10,967 tons of 96° sugar, as against 12,800 tons in 1922. During the fiscal year 1921–22 11,085 tons of sugar were exported and the following year about 7073 tons. The importations of sugar were not separately classified for the year 1921-22, but for the year 1922-23 importations of sugar amounted to 1414 tons. The local consumption of sugar during 1923 amounted to 1286 tons of white sugar and 123 tons of raw sugar. This is slightly in excess of the consumption during the previous year. The manufacture of sugar in Haiti has never been developed to the extent to which natural climatic and agricultural conditions of the country would appear to warrant. But foreign capital seeking investment in this field has found the greatest difficulty in obtaining sufficient land contiguous to any selected site for a sugar mill, to permit operations on a basis large enough to be profitable.

The Imperial College of Tropical Agriculture, Trinidad, recently appointed Mr. **Overton F. Boyd** to be the Sugar Technologist on the staff of the college. He is an American chemist and is son of the President of the Louisiana State University where he graduated. Since 1912 he has been chemist to the United Fruit Company at Los Mochis, Mexico; chemist at San Isidro, Santo Domingo; chief chemist of the Consuelo Sugar Company; Superintendent of the Terrebonne Refinery, Louisiana; and Refinery Superintendent of Wilbert Refinery where the sulphitation process is in vogue. He has also acted as Superintendent of the Haytian-American Sugar Company; Special Chemist at Oxnard factory of the American Beet Sugar Company; and Refinery Superintendent at Gunthorpe's factory, Antigua. Mr. **Boyd**, has thus, it will be seen, had a varied experience in both cane and beet sugar technology, which should serve him well in his new post.

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[1] *I.S.J.*, 1916, 502 and 558.
[2] *I.S.J.*, 1924, 333, an abstract of a paper to be published in full later.
[3] *I.S.J.*, 1923, 587.
[4] *I.S.J.*, 1923, 204.

The 1923 Java Sugar Crop.

By H. C. PRINSEN GEERLIGS, Ph.D.

During 1923, 179 sugar factories were active in Java, against 182 in 1922. The factory of Madjenang was closed and dismantled, while Seboroh did not plant for the season under consideration. The cane of Pongok was worked up in the Karang Anom mill, belonging to the same owners.

The sugar estates planted and harvested an area of 162,481 hectares (or 401,485 acres), against 160,908 hectares (or 397,443 acres) in 1922. This acreage is still somewhat below the one achieved in 1918, which up to now constitutes the maximum planting in any year in Java. The total amount of cane harvested was 16,078,051 tons,[1] equivalent to 40·04 tons to the acre. The total sugar crop amounted to 1,764,636 tons or 9845 lbs. to the acre.

We have calculated the figures for the different residencies and the totals and averages in tons, pounds, acres, etc., after the data given by Mr. J. VAN HARREVELD in the *Archief voor de Java Suikerindustrie.*[2]

The season proved a good one, although not so good as the two foregoing ones, when more sugar to the acre was obtained. At the outset the expectations were not so bright, as is clearly shown by the subsequent estimates of the United Java Sugar Producers of their share of the total production. These estimates, expressed in piculs of 136·16 lbs., were as follows at the dates indicated:—

Date.	Estimate.
31st May	25,174,077
30th June	25,440,167
31st July	25,453,460
31st August	25,743,151
30th September	25,838,317
31st October	25,927,942
Final result	25,928,317

The average tonnage amounted to 40·04 tons per acre, which is less than in 1922; but is anyhow very satisfactory in comparison with other years. In this year the residency of Kedoe reported the largest figure, immediately followed by Banjoemas, while Soerakarta was lowest in this respect with only 36·96 tons of cane to the acre.

The sugar content of the cane was very good, allowing an average sugar extraction of 10·97 per cent. The highest extraction was attained in the residency of Madioen with 11·49 per cent. and the lowest in that of Besoeki with 10·03 per cent.

The highest average yield of sugar to the acre is reported from the residency of Kedoe with 11,491 lbs. and the lowest from Soerabaja with 9094 lbs.

The maximum figure for one single factory was witnessed in the residency of Djokdjakarta, where the same estate as in 1922 (Gondang Lipoero) scored the highest output of sugar to the acre with the same figure as last year, namely, 14,480 lbs.

In perusing the list of cane varieties planted we see again a decrease in the older ones, B. 247 and P.O.J. 100, while the newer kinds, E.K. 28 and D.L. 52, are steadily coming forward. The distribution of the other sorts among the plantations remains rather stationary.

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[1] Tons of 2240 lbs. [2] 1924, 287.

The 1923 Java Sugar Crop.

I.—Cane Crop.

Residencies and Totals.	Number of Factories in Operation.	Land under Cane.		Cane Harvested.		
		Hectares.	Acres.	Tons [1]	Tons per acre.	Kilograms per Hectare.
Cheribon	12	10,042	24,813	1,052,713	42.36	106,338
Pekalongan	18	16,927	41,826	1,754,350	41.43	104,250
Banjoemas	5	4,874	12,041	536,921	44.51	111,734
Kedoe	2	3,468	8,569	394,880	46.08	115,650
Djokdjakarta	17	15,689	38,767	1,476,260	37.89	95,113
Soerakarta	14	14,450	35,713	1,319,813	36.96	92,763
Semarang	12	9,811	24,242	981,703	40.39	101,639
Madioen	6	6,963	17,205	690,811	40.14	100,769
Kediri	21	23,104	57,089	2,289,046	40.07	100,595
Soerabaja	36	27,302	67,462	2,621,407	38 82	97,462
Pasoeroean	27	23,385	57,781	2,280,217	38.72	97,201
Besoeki	9	6,466	15,977	679,930	41.81	104,946
Total **1923**	**179**	**162,481**	**401,485**	**16,078,051**	**40.04**	**99,986**
,, 1922	182	160,908	397,443	16,759,106	42.05	105,816
,, 1921	183	159,474	394,060	14,939,679	37.89	95,125
,, 1920	183	156,069	385,647	14,398,238	37.34	93,732
,, 1919	179	137,655	340,138	13,075,128	38.10	96,517
,, 1918	186	163,071	402,943	15,637,342	38.44	97,387
,, 1917	185	160,439	396,440	17,079,303	43.09	108,179
,, 1916	186	155,165	385,290	15,878,300	41.11	103,218
,, 1915	186	151,165	373,500	14,189,000	37.97	96,385
,, 1914	186	147,465	366,000	14,901,000	40.87	102,000

[1] Tons of 2240 lbs.

II.—Sugar Extracted.

Residencies and Averages.	Kilograms per hectare.	Lbs. per acre.	On 100 Cane.	Yearly maximum output of any single factory.	
				Kilograms per hectare.	Lbs. per acre.
Cheribon	12,009	10,707	11.29	11,705	10,420
Pekalongan	11,835	10,505	11.35	14,360	12,709
Banjoemas	11,661	10,394	10.44	14,229	12,593
Kedoe	12,879	11,491	11.14	12,881	11,400
Djokdjakarta	11,139	9,946	11.71	16,362	14,480
Soerakarta	10,703	9,542	11.54	15,143	13,401
Semarang	11,139	9,946	10.96	14,761	13,063
Madioen	11,574	10,326	11.49	13,897	12,301
Kediri	10,965	9,789	10.90	13,750	12,167
Soerabaja	10,181	9,094	10.45	14,011	12,400
Pasœroean	10,355	9,251	10.65	13,315	11,784
Besoeki	10,529	9,386	10.03	13,142	11,631
Average, **1923**	**10,965**	**9,784**	**10.97**	**16,362**	**14,480**
,, **1922**	**11,226**	**9,950**	**10,61**	**16,362**	**14,480**
,, **1921**	**10,517**	**9,321**	**11.04**	**17,911**	**15,875**
,, **1920**	**9,892**	**8,826**	**10.55**	**15,178**	**13,540**
,, **1919**	**9,706**	**8,657**	**10.06**	**14,639**	**12,957**
,, **1918**	**10,904**	**9,723**	**11.19**	**15,996**	**14,265**
,, **1917**	**11,382**	**10,117**	**10.50**	**16,415**	**14,696**
,, **1916**	**10,355**	**9,238**	**10.03**	**15,300**	**13,650**
,, **1915**	**8,729**	**7,788**	**9.15**	**12,941**	**11,546**
,, **1914**	**9,526**	**8,495**	**9.28**	**14,125**	**12,602**

III.—SUGAR PRODUCTION IN TONS.

Residencies and Totals..	First Sugars.	After Products.	Total Production: After-products as 4 : 3	Solidified Molasses.
Cheribon	116,341	3,147	118,601	2,272
Pekalongan	195,255	4,266	198,455	14,446
Banjoemas	56,229	—	56,229	1,080
Kedoe	43,756	109	43,838	4,329
Djokdjakarta	171,350	1,463	172,447	—
Soerakarta	151,495	1,298	152,447	—
Semarang	106,159	1,281	107,125	6,488
Madioen	78,956	540	79,361	2,766
Kediri	243,729	8,430	250,353	26,821
Soerabaja	271,545	4,085	274,608	20,293
Pasoeroean	239,264	6,302	243,686	21,580
Besoeki	66,816	734	67,361	3,767
Total, **1923**	**1,740,895**	**31,655**	**1,764,636**	**103,842**
„ 1922	1,749,649	39,609	1,779,557	62,125
„ 1921	1,632,067	34,620	1,658,032	74,892
„ 1920	1,497,244	30,060	1,519,562	164,459
„ 1919	1,297,320	23,977	1,315,158	96,303
„ 1918	1,714,833	101,922	1,750,197	18,511
„ 1917	1,779,654	22,682	1,793,415	49,870
„ 1916	1,579,670	32,300	1,604,154	85,749
„ 1915	1,273,190	35,312	1,298,307	127,543
„ 1914	1,305,246	100,061	1,382,825	94,765

Tons of 2240 lbs.

IV.—SUBDIVISION OF THE CROPS IN PERCENTAGES ACCORDING TO ASSORTMENTS.

Residencies and Averages.	White Plantation Sugar		Channel Assortment Refining Crystals, 98° pol.	Refining Crystals, 96.5° pol.	After-products.	Total
	First running.	Second running.				
Cheribon	51.5	2.7	28.7	14.5	2.6	100
Pekalongan	65.8	3.0	15.0	14.2	2.0	100
Banjoemas	—	—	71.5	28.5	—	100
Kedoe	—	—	79.2	20.6	0.2	100
Djokdjakarta	73.4	0.6	22.8	2.3	0.9	100
Soerakarta	86.3	1.5	11.4	—	0.8	100
Semarang	42.4	1.0	39.8	15.7	1.1	100
Madioen	82.8	—	16.5	—	0.7	100
Kediri	64.6	—	15.6	16.4	3.4	100
Soerabaja	60.0	1.1	19.5	17.9	1.5	100
Pasoeroean	21.3	—	49.3	27.2	2.2	100
Besoeki	—	—	70.4	28.5	1.1	100
Average **1923**	**53.11**	**1.06**	**28.91**	**15.20**	**1.72**	**100**
„ 1922	52.85	1.53	27.45	16.46	1.71	100
„ 1921	53.42	0.12	28.05	15.33	3.08	100
„ 1920	51.71	0.83	30.41	15.08	1.97	100
„ 1919	49.7	2.1	23.1	23.3	1.8	100
„ 1918	45.9	3.2	27.0	21.0	2.9	100
„ 1917	50.3	1.9	40.6	6.2	1.0	100
„ 1916	48.1	2.9	37.3	9.7	2.9	100
„ 1915	43.8	4.2	34.9	14.1	3.0	100
„ 1914	40.3	4.0	32.3	15.7	7.7	100

V.—PERCENTAGE COMPOSITION OF THE CANE PLANTINGS OF—

VARIETY.	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
B. 247	58	57	54	48	41	29	26	20½	17¼	15½
P.O.J. 100	29	30	30	31	28	16	10	6½	4	2¾
Cheribon	6	5	5	4	3	1	1	½	—	—
P.O.J. 213	1	1	1	1	1	—	—	½	—	—
E.K. 2.	1	1	2	4	4	6	6	6½	6½	6
E.K. 28	—	—	—	2	6	23	32	39	39	40
F. 90	—	—	1	2	4	4	3	3	3¼	3
D.I. 52	—	—	—	1	4	13	14	15	18½	21½
Tjep 24	—	—	—	—	2	1	1	1	—	—
S.W. 3	—	—	—	—	1	1	2	2	2½	2¾
P.O.J. 2714	—	—	—	—	—	—	—	—	2	2¾
P.O.J. 2725	—	—	—	—	—	—	—	—	1½	1
Various	5	6	7	7	6	6	5	5½	5½	4¾
Total	100	100	100	100	100	100	100	100	100	100

VI.—FACTORY RESULTS DURING THE LAST DECADE.

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
CANE—										
Sucrose	11·91	11·63	12·42	12·82	13·63	12·38	12·94	13·41	12·87	13·06
Fibre	12·61	13·26	13·14	13·02	12·99	13·01	12·98	12·98	13·19	13·14
BAGASSE—										
Sucrose	4·21	4·11	4·00	4·10	4·34	4·03	4·07	4·12	3·85	3·75
Moisture	46·27	46·64	46·97	46·82	47·22	47·01	46·76	46·43	46·30	46·49
Sucrose extraction by mills	90·4	91·9	91·1	92·3	92·1	92·0	92·5	92·5	92·9	92·2
Sucrose in filter-press cakes	6·72	7·97	4·51	4·15	4·36	3·70	3·75	3·81	3·55	3·20
Sucrose in juice on 100 cane	10·77	10·69	11·32	11·83	12·55	11·39	11·97	12·41	11·96	12·04
Purity in raw juice	80·39	82·00	84·41	85·80	86·50	83·7	85·4	85·3	84·6	84·6
Purity of final molasses	32·70	32·45	32·40	32·6	33·1	32·1	32·2	32·4	32·0	31·3
Calculated available sugar	9·94	10·00	10·80	11·40	12·17	10·60	11·31	11·73	11·23	11·51
Sugar extracted on 100 cane	9·76	9·65	10·42	11·00	11·68	10·44	11·13	11·51	11·08	11·43
SUCROSE TURNED OUT ON 100—										
Cane	9·33	9·18	10·06	10·48	11·27	10·12	10·64	11·00	10·60	10·92
Sucrose in cane	78·34	79·20	81·00	81·75	82·61	81·66	82·23	82·76	82·36	83·10
Sucrose in juice	86·63	86·40	88·90	88·58	89·80	88·85	88·90	80·6	88·34	90·71
SUCROSE LOST ON 100—										
Cane	2·58	2·45	2·36	2·34	2·36	2·26	2·30	2·41	2·27	2·14
Sucrose in cane	21·66	20·87	19·00	18·25	17·29	18·34	17·77	18·12	17·64	16·90
Sucrose in juice	13·37	13·60	11·10	11·42	10·20	11·15	11·10	11·40	11·35	9·29
LOST IN BAGASSE ON 100—										
Cane	1·14	0·94	1·10	0·99	1·08	0·99	0·97	1·00	0·91	1·02
Sucrose in cane	9·57	8·08	8·86	7·72	7·92	7·99	7·50	7·46	7·07	7·77
LOST IN FILTER-CAKES ON 100—										
Cane	0·13	0·12	0·10	0·09	0·10	0·09	0·10	0·10	0·09	0·09
Sucrose in cane	1·09	1·03	0·80	0·74	0·73	0·73	0·77	0·75	0·70	0·69
Sucrose in juice	1·21	1·12	0·88	0·80	0·80	0·79	0·80	0·81	0·75	0·72
LOST IN MOLASSES on 100—										
Cane	1·01	1·09	0·85	0·91	0·94	0·90	0·93	1·01	0·98	0·80
Sucrose in cane	8·48	9·38	6·84	7·11	6·95	7·27	7·11	7·16	7·62	6·09
Sucrose in juice	9·35	10·20	7·59	7·70	7·50	7·90	7·80	7·74	8·17	6·65
UNACCOUNTABLE LOSS ON 100—										
Cane	0·30	0·30	0·36	0·35	0·24	0·28	0·30	0·30	0·29	0·23
Sucrose in cane	2·52	2·38	2·50	2·68	2·17	2·35	2·39	2·75	2·25	2·35
Sucrose in juice	2·81	2·29	2·66	2·92	2·54	2·46	2·50	2·86	2·43	1·92

The total sugar crop amounted to 1,764,636 tons, of which 1,740,895 were first sugars and the balance consisted of after-products, calculated back to the equivalent of first runnings at the ratio of 4 : 3. The figure in the second column of Table III refers, however, to the real weight. Besides the sugar, a quantity of 103,842 tons of solidified molasses was manufactured and exported.

In 1923 the proportion, in which the different kinds of sugar were delivered, was again about the same as in the years immediately preceding. It appears that gradually every factory has found out what assortment is best adapted for its circumstances of agriculture, manufacture and situation, and that no conspicuous alterations have been considered necessary.

The data following now, concerning the figures for the factory work, have been derived from the statistics annually issued by the Chemical Department of the Java Sugar Experimental Station. But whereas the foregoing figures referred to every one of the 179 factories, the technical data relate only to 160 establishments, viz., those subscribing to the station. As these are the best controlled factories, it may be that the figures recording the work done in them are better than the total average of the 179 which have worked in 1923, although we do not believe the difference to be large.

Next to the list of averages we give here a few maximums and minimums relating to the results of the entire grinding season in the individual factories. We have not added the names as these are superfluous.

	Maximum.	Minimum.
Sucrose in cane	15·06	11·21
Fibre in cane	18·28	10·40
Sucrose in bagasse	5·40	2·80
Moisture in bagasse	51·11	41·84
Sucrose in filter-press mud (defecation)	10·41	0·55
Sucrose in filter-press mud (carbonatation)	5·53	0·16
Purity of raw juice	89·6	79·7
Purity of final molasses	34·8	26·2
Sucrose in juice on 100 cane	14·07	9·95
Calculated available sugar on 100 cane	13·92	9·31
Sugar extracted on 100 cane	13·67	9·18

The sugar content of the cane was good, in fact, much better than usual; while the purity of the raw juice was equally good, although not superior. As the extraction of the juice by the mills was also satisfactory, the amount of sucrose extracted in juice on 100 parts of cane (being 12·04 per cent. on an average) was higher, too, than in most years. The same thing was also observed for the calculated available sugar, which was 11·51 per cent., of which in reality 11·43 was extracted.

The quotient of purity of the exhausted molasses was again lower, and so was the figure for the loss of sucrose in molasses.

In general, the work done in the sugar-houses was of a good standard, both in respect of the milling work and the working up of the juice.

We also give here the data relating to the total sales of Java sugar and the portion sold by the United Java Sugar Producers, which body, according to these figures, disposed of 88·9 per cent. of the total Java crop of the year 1923.

ASSORTMENT.	TOTAL SALES. Piculs.	SALES BY U.J.S.P. Piculs.
Superior "head" sugar	15,549,266	14,272,674
Superior soft sugar	289,225	263,595
Channel assortment, 98 pol.	8,514,792	6,907,983
Raw sugar 96·5, pol.	4,356,669	4,164,334
Molasses sugar	441,424	314,903
Sack sugar	30,743	5,113
Total sales	29,182,119	25,928,317

All these figures represent piculs of 61·76 kg. or 136·16 lbs.

The 1923 Java Sugar Crop.

The United Java Sugar Producers had already begun their sales of the 1923 crop in the early days of January, 1923, at the price of 13 guilders per picul for the whites and of 12 for the raws. Prices, however, went steadily up to 17·50 guilders for the whites, and to 16 for the browns, and the Association profited so well from these favourable circumstances that at the end of March, at a period when the grinding had not yet begun, 24,464,000 piculs had already been sold. In the month of October all of the crop had been disposed of at an average price of 14·14 guilders per picul of whites, 12·84 for the picul of refining crystals basis 98° polarization, and 12·57 for the sugar basis 96·5° polarization.

We estimate the consumption in the territory of Dutch East Indies at 150,000 tons or 2,400,000 piculs, while the balance is disposable for exportation.

The destination of the exportation from the 1923 sugar crop has been the following in tons of 2240 lbs.; and we give the corresponding figures for a few previous years as a comparison. The stocks of sugar still present at the beginning of the grinding in 1923 are estimated at about 10,000 tons and those on the 30th of April, 1924, at 22,300 tons.

Exportation of Java Sugar.

Tons of 2240 lbs.

Destination.	1919/20	1920/21	1921/22	1922/23	1923/24
Netherlands	21,283	9,804	10,222	32,528	7,473
Belgium	—	7,396	—	2,702	5,694
United Kingdom	119,528	50,642	9,124	102,069	231,338
France	41,636	10,013	10,124	83,957	83,768
Germany	—	—	104	13,023	61
Russia and Finland	1,414	10,922	4,000	11,261	—
Denmark	2,370	—	681	26	—
Sweden	14,522	27,807	—	—	6,007
Norway	50,152	31,008	—	2,322	851
Italy	45,956	18,166	33,502	8,865	6,639
Portugal	—	1,000	—	—	—
Spain	6,919	3,004	—	—	—
Greece	8,239	5,907	5,875	9,610	16,949
Rumania	3,921	3,070	3,756	—	—
Servia	—	—	951	2,256	—
Turkey	23,231	2,174	9.049	11,664	2,582
Port Said, etc., f.o.	67,124	365,473	61,454	159,043	151,298
Smyrna	—	—	—	5,498	—
United States	—	237,162	300	—	23,457
Vancouver	2,953	—	5,020	7,000	12,319
Arabia	—	—	—	—	50
British India	336,000	212,562	625,909	440,538	413,784
Aden	—	—	—	—	981
Penang	—	—	—	—	11,548
Singapore	64,568	41,450	70,041	60,780	55,496
Saigon	—	—	—	—	4,005
Siam	3,428	2,358	3,565	17,650	11,484
Dairen	—	—	—	—	3,981
China	3,525	3,765	32,638	30,751	19,141
Hong Kong	184,422	171,398	319,126	258,513	245,279
Japan and Formosa	272,187	94,473	353,787	279,883	280,302
Australia	82,718	63,362	5,447	4,435	263
New Zealand	—	—	—	—	17,741
Other Countries	3,152	644	20	2,802	2,255
Total	**1,359,348**	**1,373,560**	**1,564,695**	**1,547,176**	**1,614,746**

Exhaustion of Final Molasses in the Cane Factory at 92 to 94° Brix.

By CYRIL A. HINDS.

Authorities agree that to exhaust the final molasses in the manufacture of cane sugar it is necessary to concentrate the low grade strikes to at least 90° Brix. What I have to say, therefore, may seem very unorthodox.

I have never found it necessary to concentrate to more than 94° Brix, in fact, anything between 92° and 94° Brix exhausts the molasses all that is necessary. I always aim at getting 93° Brix on low-grade strikes.

I am aware that my opinions are not unlikely to raise some protest, but I give the results as I find them, and they are the results of ten years of experience. And I am writing with the hope that such experience will be useful to some chemist or superintendent who has to work with the not uncommon arrangement of too few centrifugals for mill capacity.

In addition to the degree of concentration, four things are necessary for the exhaustion of final molasses:—

(1) Good clarification;
(2) Careful and slow boiling of the low-grade strikes;
(3) A sufficiently low purity of the massecuite; and
(4) A sufficiently long time in crystallizers for massecuite to reach the temperature of the air.

One great advantage of the combination of proper clarification, with special attention to the avoidance of excess of lime, and slow boiling at a high vacuum, is that there is no frothy fermentation in the crystallizers. In this way more crystallizer space is available, as we can make larger low-grade strikes. This is decidedly worth while where the crystallizer capacity is limited.

A small amount of soda ash can also with advantage be added to the second molasses used in the low-grade strikes, the amount depending on conditions in each factory. This helps in diminishing the viscosity of the final massecuite, and we believe the decomposition of organic calcium salts is another factor in avoiding frothy fermentation.

To bear out my point that 93° Brix concentration is enough for low-grade massecuites, I will give the following average figures from an actual crop:—

	BRIX.	SUCROSE.	PURITY.
Normal juice	17·26	14·02	81·25
Final massecuite	92·92	53·26	57·3
,, molasses	83·84	23·85	28·45

Gallons molasses per ton cane, 4·36.

This last figure, expressing the amount of molasses per ton cane, is a very necessary one, but how often do we see reports in which great stress in laid on molasses purity and nothing said of the gallons produced.

The accompanying table gives particulars of every low-grade strike included in the above averages, and is copied direct from the crystallizer record book, being all the strikes cured up to the shut-down.

Of these strikes the only two which gave any difficulty in curing were those marked (1). How easily the average strikes are cured can be appreciated from the fact that, grinding between 1000 and 1020 short tons of cane a day, all the low-grade massecuite is cured on eight 30-in. Hepworth machines, which never run while the mill is shut down. It will be seen that there was no strike in any crystallizer for less than six days, so cooling to air temperature did not inordinately increase the viscosity of the massecuite.

Strike No.	Date Filled	Massecuite			Date Purged.	Molasses.		
		Brix.	Sucrose	Purity		Brix.	Sucrose.	Purity.
11	Feb. 14	93·8	54·0	57·5		82·2	22·44	27·2
17	28	91·6	49·2	53·7		84·4	24·80	29·3
18	28	93·2	54·6	58·5		82·4	24·64	29·9
21	29	93·0	55·3	59·5		84·0	24·20	28·8
27	March 5	93·2	52·4	56·2	March 12	85·4	24·20	28·4
31	6	92·4	52·0	56·2	13	84·4	25·08	29·7
34	6	93·4	53·0	55·5	13	84·8	23·32	27·5
38	7	92·2	52·8	57·2	14	84·4	24·64	29·1
(1) 45	12	92·2	52·4	56·8	19	83·1	25·08	30·2
49	13	93·6	55·6	59·4	20	82·0	24·20	29·5
54	13	92·6	54·6	58·9	21	84·4	24·20	28·6
58	14	92·4	54·0	58·4	22	84·6	23·76	28·0
62	14	93·0	55·2	59·4	26	83·4	24·64	29·5
66	15	93·4	55·2	59·1	26	84·0	23·32	27·7
69	19	93·0	51·0	54·8	27	82·1	23·32	28·5
75	20	92·8	50·4	54·3	28	84·8	24·20	28·5
79	21	92·8	51·0	54·9	29	83·0	22·88	27·5
83	21	92·8	52·6	56·6	April 2	83·8	23·32	27·9
87	22	93·4	53·4	57·1	2	84·2	23·76	28·2
92	26	92·4	52·0	56·2	3	83·4	22·88	27·4
97	26	93·8	54·8	58·4	4	84·3	24·42	28·9
102	27	93·4	52·0	55·6	5	84·8	23·32	27·5
106	28	92·4	52·6	56·9	5	82·8	22·00	26·5
110	28	93·6	55·8	59·6	8	83·6	23·76	28·4
117	April 2	92·2	54·0	58·5	11	85·0	24·20	28·4
121	3	93·0	52·4	56·3	10	83·6	22·00	26·1
(1) 125	3	93·2	54·8	58·7	17	82·6	24·20	29·2
129	4	93·4	55·6	59·5	10	84·6	25·08	29·6
133	4	92·2	53·4	57·9	11	83·8	23·76	28·3
138	5	93·6	54·0	57·6	12	84·4	24·64	29·1
141	5	93·4	53·6	57·3	14	84·2	24·20	28·7
146	9	92·8	52·4	56·4	15	84·0	24·20	28·8
150	9	92·2	51·2	55·5	16	84·2	22·44	26·6
Average		92·92	53·26	57·3		83·84	23·85	28·45

We make our molasses sugar into magma with first molasses, this magma being taken back to the pans as seed. As we do not want any accumulation of gums in the factory, we do not object to a little water judiciously used on the massecuite if there is "gum" present. But we control this by paying the centrifugal men according to the purity of the final molasses, so that they think that they are as interested as we are in getting low purity molasses.

We must give our reasons for believing 93° Brix is high enough for a final massecuite. They are:

(1) There is free movement of the grain in the mother-liquor. With massecuite boiled hard, say to 97° Brix, the paddles only set up a wave movement in the mass. Each grain exhausts the surrounding film of molasses, but there is not enough freedom of movement for it to move from its relative position. So between these exhausted films there remains comparatively unexhausted molasses. This condition can be cured to a certain extent by increasing the speed of the crystallizer paddles.

(2) At 93° Brix, or even a little lower, the mother-liquor is already supersaturated with respect to sugar and water from the non-sucrose components; the water evaporated after this point is hygroscopic, the evaporation of which water can in no way cause the crystallization of more sugar.

Cattle Feeding in Mauritius.

The proper feeding of animals in the past was a very important part of the sugar planter's work, but with the increasing introduction of power implements this is becoming less so than before. The balance between the various methods of cultivation, manual and by animal and power implements, has been disturbed, and it is by no means settled what part cattle will eventually be called upon to fulfil in different areas. It is probable that they will always be needed and, for various reasons, it is to be hoped that this will be the case; the subject of their treatment is therefore well worth careful study. A useful addition to the literature for this study, as far as sugar cane plantations in the tropics are concerned, is offered in a recent bulletin[1] issued by the Mauritius Agricultural Department, and a consideration of its contents is here presented to the readers of this journal. The character of the bulletin is two-fold, in that the bulk of it is devoted to a clear and simple statement of the principles of cattle feeding, while a great number of the common food stuffs to be met with in the tropics, and specifically to be found in Mauritius, are subjected to a more useful analysis than is usual in such publications. It is claimed that in Mauritius there is likely to be an important extension of implemental cultivation which should lead to an increased demand for working cattle, so that the matter is one of more than ordinary local importance.

The information as to the common fodders in this island is drawn from various reports by BONAME, supplemented, as to leguminous plants by DE SORNAY'S "Les Plantes Legumineuses," and a circular issued by the Department, in 1915, containing analyses of the more important local fodders together with prescriptions for feeding. Prefacing this accumulated mass of information on local food stuffs, is a concise statement "of the chief facts relating to the composition, digestibility and other properties of foods and of the principles upon which the construction of rations for farm animals under various circumstances is based." The result is a handy and readable account of what is usually a somewhat dry and intricate subject, which places in the hands of every planter a method by which he can with the least possible trouble apportion rations for all classes of cattle on the plantation. The subject matter is divided up under the following headings:—Composition of food stuffs, Digestibility of feeding stuffs, Standard rations, Precautions in feeding, a Table of the constituents of 68 food stuffs common in Mauritius, Compounding of rations, with a short appendix on the importance of vitamins in food.

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[1] "The Feeding of Working and Dairy Cattle in Mauritius." R. LAVAL. Bulletin No. 29, General Series, Department of Agriculture, Mauritius, 1923.

Composition of food stuffs.—The main constituents (apart from water) are as usual divided into (1) Nitrogenous, including albuminoids, and amino compounds and amides, and (2) Non-nitrogenous, including soluble carbohydrates, crude fibre, fats and oils, and mineral matter or ash. The *albuminoids* or *proteins* are an essential part of all living matter, and contain on the average 16 per cent. of nitrogen ; the amount of albuminoid in a food is usually calculated on this assumption from the amount of nitrogen obtained on analysis. The relative feeding value of these proteins differs, and it has been found that a mixed diet often gives a better result than a simple one with the same amount of nitrogenous matter. The main function of proteins is to build up the nitrogenous tissues of the animal and to make good the daily nitrogenous waste, hence they have been termed "flesh formers." They are rendered digestible by ferments, pepsin in the stomach and trypsin in the pancreas. The *amides* are soluble and need no digestion ; they do not form muscle but, while preserving to some extent the nitrogenous constituents of the body, they yield heat and energy. *Oils and fats* are found in large numbers in vegetable tissues and, in the analysis of feeding stuffs, the amount of substance soluble in ether is assumed to be mainly fat. Their function is to produce heat and energy through oxidation and combustion in the blood. Fats are made digestible mainly by the bile, aided by the pancreatic juice and secretions in the intestines. Of the *carbohydrates*, starch is the most important but sugar is sometimes present in considerable quantities, for instance, in roots. Sugar being soluble in cold water needs no preparation for digestion, but starch has to be acted on by ferments, these being ptyalin in the saliva, as well as those in the pancreas, and the acid secretion of the stomach. These carbohydrates are the fuel of the body and are the chief sources of the capacity of the animal for work and the heat this produces. They are also the chief fattening constituents of food, as any surplus not required for work is laid down as fat in the animal. *Crude fibre* consists chiefly of cellulose which constitutes the vegetable framework of all plants, but this substance sometimes undergoes a change in straw and hay. Fibre is very partially digestible, and when this takes place it is probably due to the action of bacteria in the large intestine ; but animals differ in their capacity for using it as food, cattle being more able to do so than horses and horses than pigs. The food value is therefore small, but fibre plays the part of giving bulk to the ration, a matter of considerable importance especially to ruminants. *Mineral matter or ash* consists chiefly of compounds of phosphorus, sulphur, calcium and magnesium, with smaller quantities of iron, sodium and chlorine and traces of fluorine, while cereal straw contains a large proportion of silica which is also present in grasses. The functions of the mineral constituents of the food are to build up the skeleton of the animal and provide the necessary saline constituents for the blood, gastric juice and other fluids and secretions of the body, as well as to supply certain elements (such as phosphorus, iron and sulphur) which are integral parts of the blood corpuscles.

Digestibility of feeding stuffs.—This appears to depend less on the inherent digestibility of the food than on other circumstances, e.g., the species, age, condition and individual idiosyncracy of the animal. The method of analysis of food digested is first of all to make one of the food supplied and then one of the collected faeces and determine the difference, but these processes are difficult to carry out and contain rather numerous possible errors. Such experiments appear not as yet to have been done in Mauritius, but rough estimates can be made by the use of certain factors obtained by KELLNER. These factors are as follows: Ruminants have as we have seen greater digesting powers than horses and these latter than pigs, and especially as regards fibrous foods. The digestibility of a food has no reference to the ease with which it may be assimilable, but rather to the attractiveness of the food to the particular animal; foods eaten with relish are almost invariably more successful than those that for any cause have become distasteful. Gentle exercise promotes and hard work diminishes the animal's power of digestion; but the quantity of food supplied has little effect, unless where given in excess, when this is decreased. Addition of carbohydrates to the ration diminishes digestibility considerably, whereas the addition of proteins tends to increase it, especially in rations rich in carbohydrates. Fat if well incorporated has little effect if given in moderate quantities, but if enough is added to give the food an oily character it becomes repellant (e.g., over 1 lb. to every 1000 lbs. of body weight of animal).

The approximate percentage of digestible matter in seeds, green fodder, and dry fodder can be obtained by multiplying the percentages of the constituents obtained on analysis by certain factors. These factors are, for cellulose and non-nitrogenous matter, 0·7, 0·67, and 0·43 respectively; for fats, 0·9, 0·62, and 0·50; and for crude proteins, 0·9, 0·7, and 0·65. This means that, for every ounce of cellulose or non-nitrogenous matter in seeds, 0·7 oz. is digestible, in green fodders 0·67 oz., and in hay 0·43 oz. Such studies have led to a formula which can be applied to all compounded foods and which is called the *albuminoid ratio*. This is simply the proportion of digestible non-albuminoid constituents to the albuminoid; and the various non-albuminoid substances are reduced to a common basis by determining their equivalent in starch. The *starch equivalent* of any substance is found by measuring the respective amount of heat given out by such substance and starch. It has been found that the albuminoid ration of an animal must not fall outside certain limits which vary with circumstances, or either its health and condition will suffer or a waste of food will be entailed. A ratio of 5–6 to 1 is termed a medium one, 2–4 to 1 is a narrow one, and 8–12 to 1 is a wide one. Fattening animals get on well with a fairly wide ratio, such as 8–10 to 1, though it should be somewhat narrower for young animals; young growing animals, animals with young, and cows in milk need a narrow ratio, i.e., one rich in proteins, such as 5 to 1.

Standard rations.—These for animals of different ages and in different conditions of life or working can be gauged from a table quoted from KELLNER, giving feeding standards per day and per 1000 lbs. live weight. This gives in separate columns the dry matter of the ration in lbs., as well as the digestible crude protein, fat, and carbohydrates. The animals are separated into adult and growing, and again into oxen, milch cows, and calves. To the oxen are apportioned rations according as they are at rest and in light, medium, and heavy work, and when fattening; the milch cows are dealt with according to the lbs. of milk they are giving, namely, 10, 20, 30, and 40 lbs. daily; lastly, the calves are divided into groups as regards age and live weight: thus, calves 2–3 months' old and weighing 150 lbs., those 3–6 months' old and weighing 300 lbs., and 6–12, 12–18, and 18–24 months' old weighing respectively 500, 700, and 900 lbs. A suitable ration is added opposite each of these different classes of animals. To give a few examples drawn from each class:—

	Total Dry Weight.	Protein.	Fat.	Carbohydrates, lbs.
Oxen at rest	15-21	0·8	0·1	7·5-9·5
Oxen in heavy work	25-30	2·2	0·8	14·2
Oxen fattening	24-32	2·0	0·7	13-16
Cows giving 20 lbs. milk daily	25-29	2·1	0·5	12·2
Calves 6-12 months old (500 lbs.)	26	2·6	0·6	12·7

Certain other matters connected with feeding are mentioned as of importance. Adequate supplies of mineral matter should not be neglected. The daily requirement of common salt by a cow of average weight is ¾ to 1½ oz., a horse needs ½ to 1 oz., and a sheep or pig one-eighth to one quarter, and the quantity should be doubled if the food is hard to digest. For a fattening ox 1 oz. of phosphorus pentoxide and 2 oz. of lime per day per 1000 lbs. live weight are sufficient, but these amounts should be increased for growing animals. Water is of course of supreme importance, and it is stated that total absence is more serious even than that of food. Usually animals will take what they require, but their food should not be too watery or salt, or they may have too much. The result of too much water is softening of the tissues which renders the animals more liable to injury and disease, and dilution of the digestive juices. It has been found that for 1 kg. of dry matter pigs take 7–8, cows 4–6, oxen 4–5, and horses 2–3 kg. of water. The importance of the fact that the water should be good is emphasized by saying that it is as necessary to choose it for animals as for human beings.

Various precautions are suggested in the use of certain foods, new ones, those containing traces of poisons, hard seeds, and so on. Where changes are made it is important that these should be gradual, presumably to accustom the digestive tract to the change; and this is especially the case where there are traces of poison, as in manioc. Special treatment is recommended for certain local foodstuffs, but these are of less general interest. For unhusked paddy partial crushing, soaking with boiling water and then mixing with bran, is said to give the best results.

Table II which concludes the bulletin contains details regarding a large number of foodstuffs found in Mauritius. These are divided into the following classes:—Green fodders, tubers, seeds, brans and meals, and sugar wastes (molasses and molascuit). In each case both the composition and the digestible constituents are given; the former including percentage of water, has crude fibre, fats and oils, protein and carbohydrates; and the latter, fibre, fats and oils, proteins and carbohydrates. These columns are followed by the albuminoid ratio and starch equivalent of the food. With this table and that preceding on standard rations, it should be no very difficult matter to compound rations in specific cases, compare nutritive values, and substitute one food for another according to availability. An example is given of such work in the preparation of a ration for an ox doing medium work. According to Table I the requisites are 22–28 lbs. total dry matter, including 1·7 lbs. of digestible protein, 0·5 of digestible fat, and 12·2 of digestible carbohydrates. In practice such an animal receives about 40 lbs. of green fodder, say grasses, and the average of Mauritius green fodders is seen in Table II to be total dry matter 10·8 lbs., proteins 0·52, fats 0·4, and carbohydrates 3·40. On inspection of the other fodders in Table II, the deficiency (obtained by subtraction) can be more or less made good by adding to the 40 lbs. of grass, 4 lbs. each of manioc, maize, dholl, and bran.

C. A. B.

Recent Work in Cane Agriculture.

Experiments with Varieties of Sugar Cane, 1920-22, together with a Summary of the Results from 1917 to 1922. *Bulletin No. 30, General Series, Department of Agriculture, Mauritius, 1924.*

In presenting this bulletin the Director, Dr. H. A. Tempany, states that "the results are the accumulation of six years' continuous work and certain of the conclusions can be regarded with confidence. The Department of Agriculture is now able to recommend to planters some 15 new cane varieties which are of equal or superior merit to the standard canes under cultivation." The previous bulletins dealing with the subject are Nos. 20 and 23 in the same series, giving results for 1917-19 and 1918-20 respectively.[1] Such results were obtained in the following manner. Each year the seedlings are cut and weighed, and the best in yield are planted out at Réduit or Pamplemousses in six holes each. In the next year those further selected from these are planted in 40 holes each, as is also done with any introduced varieties which have proved satisfactory. Lastly, in the third year, those most promising are sent out to various selected estates where they are planted in 60 hole plots. A summary is periodically prepared from which planters may learn which new seedlings and varieties are most likely to succeed in their locality.

Table I gives a somewhat detailed botanical description of all the varieties under experimental cultivation, to the number of 157. In Table II a short description is given of the experimental stations of Réduit (1000′), Pamplemousses (200′), and Long Mountain (450′), and four selected estates (100′ to 1300′), on which the canes are grown, with average rainfall and character of the soil. As yet there have been no experiments on irrigated land, but the establishment of an experimental station at Medina will introduce such experiments during the present year.

Table III compares the average results in kg. of sucrose per acre of the varieties as plants and ratoons, on all stations between 1917 and 1922, separating them according to the number of trials into three classes, namely, 30 varieties with 30-40 trials, 15 with 20–30, and 30 with under 20 trials. The average production is given for each group, the varieties are arranged in order of yield, and their departures from the mean are also given. Group 1 shows an average yield of 3469 kg. sucrose per acre, with an average of 36 trials each ; Group 2, 3154 kg. with an average of 24 trials ; and Group 3, 2918 kg. of sucrose with an average of 14 trials. The decrease of sucrose obtained from Group 1 to 3 strikes one at once, and the author suggests that this indicates that those varieties which appeared to be of less promise at first have not since received so much attention. As a result of this series of experiments, the following varieties are picked out as more or less reliable for cultivation on some scale:—D 109, RP 8, RP 6, 33/231, DK 74, B 6308, 55/1182, 55/453, POJ 213, RP 73, B 6450, B 3390, 188^{07}, 33/187, 33/55, 15^{04}.

Table IV gives the average composition of the whole 75 cane varieties, as to sucrose percentage in the juice and cane, and fibre in the cane, the canes being arranged according to their places of origin. Tables V and VI deal with over 100 recent Mauritius seedlings, which have been under trial for a comparatively short period. These seedlings were raised between 1916 and 1919 and have only been tested at the two major experiment stations. It was found that, generally, the yield in tons of cane per acre was considerably greater at the higher elevation of Réduit, while the sucrose content of the juice was similarly higher in the lower level of Pamplemousses. The first of the Tables gives the analysis of the juice, the sucrose in the cane, the weight of canes reaped, and kilograms of sucrose per acre ; while the second Table gives the order of merit of the seedlings as to the last particular.

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[1] *I.S.J.*, 1921, p. 325 and 1922, p. 86.

CANE PRODUCTION COSTS IN CUBA. *Jett Lauck. Abstract in "Facts about Sugar," April 12th, 1924, of a Report presented to the Tariff Commission in the United States.*

The great bulk of the cane is cultivated by colonos or planters and sold to the mills. Accurate statistics appear to be unobtainable, but the amount of cane grown by colonos in the island is variously estimated at 75 to 90 per cent. of the total. These planters are frequently men of standing and wealth and have considerable political influence, so that unnecessary interference by the Government in the industry is reduced to a minimum. The average size of the colonias is about 40 caballerias (at 33 acres to the caballeria this comes to about 1330 acres) ; there are many of less area than this, but some are much larger, extending to as much as 10,000 acres ; but again the absence of accurate statistics prevents any definite statements. This system is firmly implanted in the island and, as it brings considerable profits to both the growers and the sugar makers, there is little likelihood of it being changed. The mills are relieved of much responsibility and friction, and the political influence of the industry ensures the necessary legislation for the supply of sufficient labour. The cane is milled on the share system and probably not more than 10 per cent. of all the cane is grown by the mills themselves. The return obtained on cultivation depends largely on the care exercised in it, and thus there is a direct incentive towards agricultural improvement ; but, on the other hand, the profits are so good that most growers are content with following the old and backward field practices. When the price of sugar falls, however, it is satisfactory to know that the path automatically lies open for the introduction of more up-to-date work in the plantations.

In these and in other respects Cuba can be somewhat sharply separated into two entirely different areas, namely, the older western and the newer eastern portions, the latter comprising in the main the provinces of Camaguey and Oriente. The land in the west is split up into comparatively small holdings and these are usually privately owned; there are numerous mills, and transport by road and railway is easy, so that the colonos have the advantage of a considerable amount of competition among the mills for their canes. This places the colono in a superior position and the "percentage"[1] paid to him by the mills runs as high as 6 to 8 ; further, as the cultivation is done to a great extent by the members of his own family, costs of labour are reduced and the profits of cultivation increased. On the other hand, the land is older and more cultivation is necessary, and ratoons are only possible from five to ten years, depending on the care taken in the treatment of the fields. In the eastern section the land has been more recently opened up, the holdings are a good deal larger and some of the mills have been able to acquire large areas. The land is more fertile and the yields of cane greater, and there is a larger amount of sugar in the cane. The mills are more widely scattered and usually have their own railways, so that competition between them for the cane is reduced to a minimum. All this causes the percentage paid to the grower to be less than in the west, and it is roughly 4½ to 6, according as the land is owned by the mill or is private property. This smaller percentage is more or less equalized by the greater yield per acre, which reduces the cost of cultivation ; less cultivation is also needed and the ratoons can be grown for a longer period (seven to fifteen years), but labour is dearer because it has to be hired. The expense of opening up new land is estimated by the mills at $1600 to $1900 per caballeria, of which on their own land they advance up to two-thirds and, after that, for high cultivation $400 to $500. Cases are, however, known where land has produced for 15 to 20 years, during which no ploughing whatever has been done, merely hoeing, and the costs have been as low as $150 per caballeria.

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[1] In the abstract of this paper it is not stated what this percentage is ; but, from the sentence quoted later on in inverted commas it would appear to be lbs. of sugar per 100 lbs. of cane.—C.A.B.

The details as to costs and profits are a little difficult to understand in the abstract, for it is not very clearly indicated as to what part of the country is being discussed; but as far as can be made out, the following refer to the western, older section. The average extraction of the mills for 1923 was 11·7 lbs. of sugar per 100 lbs. of cane, and the estimated yield of cane was 45,000 arrobas per caballeria (the arroba being 25 lbs. this would equal about 15 tons of cane per acre). On the basis of 5½ per cent. paid to the colonos and the maximum outlay of $500 per caballeria, the maximum cost to the colono for delivering the cane to the mill cars comes to $3 per 100 arrobas of cane, giving 292·5 lbs. of sugar. "The colono's portion would be 137·5 lbs. of sugar at 5½ per cent." This at prevailing market prices, say 5c. per lb., would yield $6·87 per 100 arrobas, representing a gross profit of $3·87 as minimum for this quantity of cane grown. "Assuming an 11·7 per cent. return in sugar from the cane, or 292·5 lbs. per 100 arrobas, the actual cost of cultivating and harvesting cane per 100 arrobas and per lb. of sugar would be about as follows according to the character of cultivation." The cultivation is placed in three classes, typical (meaning the worst), good or average, and maximum; and the figures for 100 arrobas of cane are $1·633, $2·16 and $2·87 respectively, those for a lb. of sugar being 0·56 c,, 0·73 c., and 0·98 c. Adding 25 per cent. to these figures as costs for superintendence, repairs and depreciation, and other expenses incurred by the colonos, "we get an actual cost of production analogous to that in Hawaii," the agricultural cost of producing a lb. of sugar being 0·70 c., 0·91 c., and 1·22 c., according to the care taken in cultivation. In the eastern portion of Cuba the yield is estimated at more like 60,000 arrobas of cane per caballeria (approximately 20·3 tons per acre), and the general range of cultivation expenses will be lower. One point with regard to this comparison with Hawaii is however emphasized, namely, that the profit of the colono which is described as "handsome" is included in the items of costs in Cuba, whereas no such profit enters the accounts in estimating the cost of making sugar in Hawaii.

PROCEEDINGS OF THE BOARD OF AGRICULTURE IN INDIA. *Bangalore, 1924. Superintendent of Government Printing, Calcutta. Subject VI. Sugar Cane Seedling Work.*

These Proceedings contain the discussions and resolutions regarding the steps to be taken to give effect to the resolutions of the Indian Sugar Committee, with special reference to the Cane-breeding Station at Coimbatore. A strong committee was formed under the chairmanship of F. NOYCE (who was also chairman of the Indian Sugar Committee). In the altered circumstances due to the introduction of the Reforms into India, and owing to the lapse of time, the views of the Sugar Committee were thoroughly examined and in some cases revised, after which a report was drawn up and submitted to the Board, by whom it was unanimously approved.

The chairman, in introducing his report, pointed out the financial difficulties in the way of obtaining money for the necessary expansion of the station in its present temporary and provincial status. The work being for all India should be directly under the central Government and not, as it is, controlled by the Madras Government. He considered the statements contained in the Sugar Committee's report of too sweeping a nature, and tending to lose the substance in seeking for the ideal. Owing to the changed financial conditions it would be impossible for some years to consider the establishment of the Central Research Institute recommended. The existing station should be definitely kept for all India work, and its scope should be enlarged so as to deal with thick tropical seedlings for those parts of the country where these can be grown, namely, the peninsula, Assam, and Burma.

The following are the chief points in the Committee's report on Subject VI, accepted, as stated above, unanimously by the Board:—

1. The Cane-breeding Station and the post of Sugar Cane Expert should be made permanent and Imperial, with immediate effect.

2. The Board did not agree with the view of the Indian Committee that to attempt to raise seedlings capable of withstanding the rough treatment of the cultivator is impracticable, but on the contrary consider that this aim should be encouraged; at the same time more rapid progress would be likely if the methods of cultivation could be improved.

3. The raising of thick cane seedlings should be immediately commenced, and the necessary increase of staff and area should be sanctioned, as well as for the extension of the work on thin cane already in progress.

4. It was considered unnecessary that a second station should be added, in Madras, for the work of cane breeding.

5. It agreed with the Indian Committee that the work at Coimbatore should be general and preliminary, and that furthur selection should be relegated to the provinces for which the seedlings had been raised. The Board's Committee would not confine the distribution of seedlings to the few provincial stations equipped for a special study of sugar cane problems, but would give large latitude to the officer in charge, even to the sending of seedlings to private individuals, provided the local agricultural officers were duly informed of such action. The acclimatization of new imported cane varieties for other parts of India should be discontinued at Coimbatore.

6. It disagreed with the suggestion that the Coimbatore station should also be a research station for Madras cane work, but considered that such a station should be started immediately by the Madras Government.

7. The investigation as to water requirements of the sugar cane being a purely provincial matter, should be dealt with in each province on its own stations, and not, as suggested by the Indian Committee, be part of the work of the Cane-breeding Station.

LA CANA UBA Y SU RENDIMIENTO DE AZUCAR EN PUERTO RICO. *F. L. Dominguez, Insular Experiment Station, Rio Piedras, Porto Rico, Bulletin No. 28, 1923.*

This bulletin of 60 pages appears to contain a somewhat complete study of the Uba cane in Porto Rico, especially as regards its juice and milling qualities; but as it is written in Spanish it is only possible to describe its contents in the most general manner. In the introduction the author gives examples of severe sugar cane epidemic diseases, and points out that, in almost every case, these have been fought by the growing of new kinds of cane; he follows these remarks by tracing the introduction and distribution of the Uba cane in the island, and describes the conditions under which it is grown and cultivated. Analyses of the juice and tonnage of cane returns are given from several hundred places where this variety has been grown, and the average of the juice analyses from all of these runs as follows:—Brix 17·68, sucrose 15·51 and purity 87·72, the plant cane being inferior in these respects to the ratoons. Dividing up the estates into lowlands and uplands, we get the following figures:—

LOWLANDS.

	BRIX.	SUCROSE.	PURITY.
Plant canes	16·72	14·50	85·52
Ratoons	18·81	16·70	88·78
Average	17·77	15·60	87·78

UPLANDS.

Plant canes	17·55	15·32	87·29
Ratoons	18·13	15·60	86·04
Average	17·78	15·43	86·78

Thus the juice of the plant canes is better in the uplands, and that of the ratoons in the lowlands; the averages of Brix and sucrose in uplands and lowlands are practically equal, but the purity is higher in the lowlands.

The chief centrals and estates are then considered in detail. Picking out certain specified centrals, the juice of those on the west coast appears to be distinctly better than those in the north. Later a comparison is drawn between the behaviour of the Uba cane in Natal and Porto Rico, quotations being drawn from a paper in this Journal on the Report of the Sugar Commission in the Union of South Africa.[1] The author concludes that the Uba cane cannot take the place of the standard canes of Porto Rico, since its juice is generally poor in sucrose; but the variety has resistant and immunity qualities which make it possible to grow it in the poorest soils, that refuse to grow other kinds. It is, therefore, possible with intelligent planting to make use of it for an increase in the total output of sugar from the island. It is inadvisable to meditate the discarding of either the standard varieties or the Uba cane, and the possibilities and requirements of the latter should be submitted to a careful study.

C. A. B.

Correspondence.

BENEFICIAL ASPECTS OF MISFORTUNES.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—I was glad to note your very frank editorial comment in your issue of April last on my article, published in the same number, on "A Beneficial Aspect of Sugar Cane Mosaic," as I like nothing better than honest criticism, particularly where, as in this case, I have the opportunity kindly offered me of defending myself or my point of view.

To begin with, I am not at all surprised or even grieved that you are not altogether enamoured of the article, for, frankly, it did not merit such appreciation. It was essentially a popular article on a subject of much present-day interest, and I did not expect you to treat it otherwise. I do think, however, that you must have perused it when in a slightly captious frame of mind to draw the conclusion that I consider the "ill winds" so desirable, an opinion that I must certainly disclaim. The title itself ought to have suggested that the benefits which have inevitably come from these disasters are but a *phase* of the whole problem. Certainly I did not wish to be construed by you or the readers of my article as asserting that the mosaic disease or other epidemics mentioned therein should be considered as in themselves blessings—that we should congratulate ourselves on our house having been burnt because we have thereby succeeded in roasting the pig! All that I wished to emphasize was the truth of the old adage that "It's an ill wind that blows nobody any good"—not by any means to minimize the seriousness and disastrousness of these plagues. These we have not been able to avoid, and out of these epidemics have inevitably come certain benefits which in the long run will do much towards neutralizing the unfortunate economic effects of the visitations. In other words, the author of that article feels that behind each of these dark agricultural clouds there has eventually been revealed the traditional silver lining. To quote Patrick Henry, "If that be treason, make the most of it!"

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[1] *I.S.J.*, 1922, pp. 456–461.

Hence we are not congratulating ourselves when mentioning the value of this or that new variety of cane, or the failure of the old Bourbon or Cheribon canes in so many countries—both splendid canes with splendid agricultural yields and high sugar content when grown under the climatic and soil conditions which permit them properly to develop; but we congratulate ourselves on the finding, largely through the working of the law that "Necessity is the mother of invention," of many other splendid varieties, some of which, in my humble judgment at least, even excel the old friends in many respects.

As regards some of the POJ seedlings which have of late been largely discarded in Java in favour of the more promising canes there, such as the EK 28 or the later developed and almost mosaic-immune POJ 2725, their use here in Porto Rico (which is at present on a very limited scale and only under the special conditions mentioned in the article, as in the case of Uba also) would not in the least signify that they are second-class canes or be an admission of failure. The history of sugar cane varietal work abounds with instances of seedlings of one country being far more successful in another totally distinct country than in its place of origin—witness the D 74 and D 95 in Louisiana, the BH 10/12 in Trinidad and Porto Rico, the SC 12/4 in Porto Rico, or the D 1135 (an absolute failure in Demerara) in Queensland—to mention but a few outstanding varieties.

While it must be admitted that the Uba is in certain respects an inferior variety and its use here is *never* advised for the rich, low lands which might be considered your typical tropical soils, except as a provisional means of reducing mosaic infection, the fact that it will produce on *poor*, *upland* and *saline* soils on which other canes—your "thick, tropical canes"—will not even grow, and give its best sugar content in just such soils, certainly makes it a most promising cane in the future economy of the island. I know of any number of cases where yields of upland soils have been doubled and trebled *in terms of pounds of sugar produced per acre*—the final and ultimate test of any variety, whether it is pretty and thick or not. As regards Natal's experience with Uba, I do not by any means agree that the difficulties sustained in that country of late, which have given rise to so much discussion, are due so much to a decline in the value of the variety as to the fact that it has been extended into more tropical conditions and richer soils than are usual in Natal and to which this cane is certainly not adapted. Uba is certainly not an ideal cane for an island like Porto Rico, but it most decidedly has its uses under certain conditions, and we would never condemn it on the grounds that it is not a "thick, tropical cane." To my way of thinking—and in my scientific work I have always striven to maintain the viewpoint of the commercial grower or manufacturer of sugar—sugar content and production per acre are far more important points in judging the behaviour of this or that variety of cane than the size or beauty of the same, and if some of the thinner, less aesthetically appealing varieties give us additional tonnage in the field and equal or better results in the factory at a cost equal to or less per ton than do some of the "heftier" varieties, then these thinner, yes, "uglier" varieties are the ones indicated for cultivation. The acid test must always and without exception be the tonnage of sugar per acre and the ton-cost of producing same.

Now, Sir, as you considered that I was "misleading and unfair to ignore all the loss and failure caused by an economic disaster," which, incidentally, I did not think I had done in my article and now trust that I have corrected in this addendum, I must state, in closing, that your discussion of cotton conditions in the United States since the advent of the boll weevil therein, coupled with your highly amusing remarks in regard to the many people in India and Africa who "must perforce go more or less without the modicum of clothing which we have managed to provide them with" is not only "misleading and unfair," but based on the most deplorable lack of knowledge of cotton-growing conditions in the United States to-day. I am really rather intrigued to know the source of the information upon which you state the interesting query, "But what about the vast areas gone out of cultivation, which have given this tract such a desolate appearance as to frighten away prospective settlers from the North?" There are *no* vast areas gone out of cultivation in the cotton section of the United States and no such desolate areas added to its area since the arrival of the weevil. As a matter of fact, *there is to-day just about 60 per cent. more land cultivated in cotton* in the southern part of the United States than there was in the year 1900, when the boll weevil was just beginning to make itself felt in southern Texas, and the frightening away of prospective settlers from the North or anywhere else is a myth pure and simple. I append hereto a part of Table XV from Bulletin 150 of the United States Bureau of the Census, pp. 38 and 39, entitled "Cotton Acreage Harvested for Selected Years," which demonstrates beyond the shadow of a doubt that there has been a steady increase in the cotton acreage of the United States since that time. Hence, you will see that your remarks in regard to the effect of the boll weevil on the world's cotton industry rest on a totally false thesis and, therefore, fall of their own weight.

YEAR.	ACREAGE.	YEAR.	ACREAGE.	YEAR.	ACREAGE.
1900	24,933,000	1904	31,215,000	1911	36,045,000
1901	26,744,000	1906	31,374,000	1913	37,089,000
1903	27,052,000	1908	32,444,000	1924	39,000,000 (Estimated)

As regards the perhaps slightly lengthy reference to the boll weevil, I have but stated actual facts, which, as a cotton grower myself, I know to be true. The statements made therein contain, not as you say a "substratum of truth," but the truth, the whole truth and nothing but the truth, about a marvellous economic change due to a great agricultural plague, the seriousness of which I have never had any intention of under-estimating. You are familiar with the very thrifty, well-balanced English farmer, whom I very greatly admire, but if you had seen as I have in the past two decades the typical one-crop southern American farmer, who bought everything he needed for his daily wants and used his cotton money to pay for imported meats, butter and even feed for his animals, gradually change to a fairly good diversified farmer, producing his own grain and meat and bacon and managing his farm as a business instead of as a routine job, I believe that you would agree with me that I have not, in an attempt to be "more journalistic than scientific," as you put it, used "poetic licence" as the basis of those opening paragraphs.

Begging your indulgence for a rather lengthy communication, I beg to remain, Sir,

Very respectfully yours,
ARTHUR H. ROSENFELD,
Special Technologist.

Insular Experiment Station,
Rio Piedras, Porto Rico,
10th May, 1924.

[We note in his letter that our correspondent now states that he appreciates the other side of the disastrous weevil infestation of the United States cotton belt, but we take leave to doubt whether he does so very fully. Our information regarding the state of this area is, of course, drawn from official sources which are assuming a distinctly pessimistic turn. We have not space nor time to give many quotations here, nor will our readers expect this Journal to expand on cotton matters, but we draw one or two striking paragraphs from articles by Sir ARTHUR SHIPLEY, a well-known economic biologist, published in the *Manchester Guardian*, which will suffice. "The authorities in the United States are thoroughly alarmed, and are massing their forces for a great frontal attack on the insignificant looking little boll weevil, which is interfering so fatally with the prosperity of the United States." In support of this statement he quotes the President of the New Orleans Cotton Exchange as follows "The supremacy of this, the greatest cotton industry in the world, and our national prosperity in consequence, is threatened by the ravages of this insect"; and the Director of the National Boll Weevil Control Association as saying "If we do not control the weevil, the nation's chief commodity for export will be reduced to negligible proportions within a decade." The loss caused by the boll weevil in Texas is estimated officially at £10,000,000 and that in the whole belt at £50,000,000.

The statement of our correspondent that the area under cotton is increasing in the U.S.A. is correct enough but, characteristically (?), he omits also to draw attention to the fact that, in spite of this considerable increase in area, the total output is and has been for some years steadily declining because of the boll weevil. In 1911 he gives the area as 36,045,000 acres, while in 1924 it is estimated at 39,000,000 acres; and yet while in1911-12 the crop was the record one of 16,000,000 bales, since then it has steadily declined, reaching only just over 8,000,000 in 1920-21, although slightly increasing to a little over 9,000,000 in the following year. We fear that we cannot accept our correspondent's implication that he has presented "not a substratum of truth . . . but the truth, the whole truth and nothing but the truth." Doubtless he is correct in his description of the prosperity of the local farmer; that is natural with the present extraordinary prices of cotton, but we fear that the longer views entertained by the United States officials are only too well founded and that, when prices become more normal, as they are bound to do, most of these farmers will find it convenient to change their crop. And their increased diversification of crops will then stand them in good stead, no doubt. But what about the national industry?

We are asked for our reference as to areas going out, and so forth: we drew our remark from a well-known textbook on the area, written by so high an authority as Mr. F. S. Earle, compiled over twenty years after the advent of the boll weevil, and are surprised that Mr. Rosenfeld does not appear to have read it. With this apparent lack of acquaintance as to the state of the industry as a whole—and a broad commercial view of crops is claimed by him—we are not surprised that as regards this country and the world at large, our correspondent is but ill-informed. With us, the work of the boll weevil is not so "amusing," because the direct effect produced by it prevents us from supplying India and Africa with cotton fabrics at a price within their limited means, as we were formerly able to do. Again to quote Sir Arthur Shipley, "the supply from America may soon be barely sufficient to keep her own cotton mills going, and the supply from Egypt has been slowly falling. Only about one-third of the total inhabitants of the planet are adequately clothed, a half are but partially clad, whilst one-sixth are absolutely nude." As to the remarks made in the above letter about the Uba cane in Porto Rico at the present time, we can only here say that we agree generally with them. A brief statement is to be found in another part of this Journal, abstracted from a comprehensive report by the Chief of the Chemical Division of the Agricultural Department of Porto Rico, indicating what place this hardy cane may be expected to take in the island.—Ed., *I.S.J.*]

Sugar Reclaiming vs. Waste Prevention.

In sugar refining the necessity for the better drying of both white and raw sugar has become apparent due to the demand by both dealer and consumer for a product which will retain its quality, weight and colour permanently. It is now quite generally agreed by technologists that sugar with less than 1 per cent. moisture will keep indefinitely without appreciable loss in polarization. This has led the more progressive men engaged in the raw sugar side of the industry to conclude that if the product is so prepared it can be held over long periods of time without deterioration; the law of supply and demand will no longer seriously affect the price which can be obtained.

The main features of the actual drying process itself are fairly well standardized at this time. Many points concerning the reclaiming of the sugar dust created during drying are, however, not so definitely settled. Two systems of sugar reclaiming are used, one being known as the dry method and the other as the wet method, the former being the earlier used.

The chief objection to the dry method (in the large refineries particularly), is the loss of sugar dust incurred. At the end of one year's time, this may be considerable. The sugar as it is thrown around in the cylinder drum of the average dryer necessarily creates a certain amount of fine sugar particles. This is due chiefly to the impact of falling crystals as they are raised and dropped in their course through the dryer. The suction caused by the dryer fan carries the greater part of this dust back through the fan and into the dust collector, where owing to the reduced air velocity existing there, the dust tends to settle. While the greater proportion of the granules fall to the bottom of the collector, a considerable portion is carried around in the vortex of the air in the centre, and is eventually carried off with the air leaving the dryer. In addition to the value of this fine sugar, which may thus be lost, a serious objection against the dry method of reclaiming sugar is the potential fire risk incurred, sugar dust being a most dangerous explosive. An explosion which occurred in a refinery in Brooklyn in June 1917, resulted in the death of twelve persons, injuring twenty-four and causing property damage estimated at one million dollars.

Another objection at times to this method of collection may be space requirements. In the average refinery space these frequently are of a severe nature and at a premium.

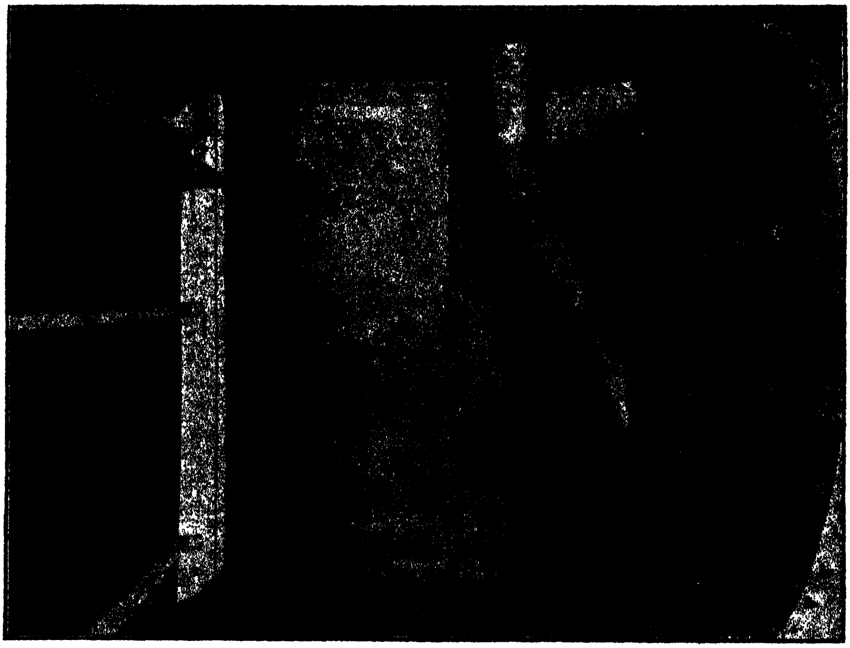

Fig. 1.—Interior of Reclaiming Chamber showing Feeding Spout and Eliminator Plates with Flooding Nozzles.

The dust collector is generally 12 ft. or more in diam. and perhaps 20 ft. in height. The expense connected with the buying of the dust collector itself, or the building of dust room, however, is not the only disadvantage, as in addition there is the cost of installing it, which may be a comparatively considerable item, especially for the small refinery.

It is only very recently that some changes of general interest have taken place in the design and construction of sugar dryers, while other proposed changes are now in course of experimentation. One manufacturer, for instance, using some form of dry collection with his dryer, has made extensive experiments in attaining the proper size and dimensions of the cone and in proportioning correctly the inlet, outlet and discharge openings. More important for the industry, however, have been the efforts of one or two manufacturers to substitute for the dry method of collection, an aspirating system which collects and removes the sugar dust at the point at which it is created. This, it is claimed, not only eliminates loss of the dust, but also makes the apparatus and the mill itself explosion-proof and saves much valuable floor space.

Most representative of the change in this direction is the so-called "reclaiming chamber" now used by the George L. Squier Co., of Buffalo, N.Y., with their sugar dryer. This new method is of the wet type rather than of the dry method used with the cyclone type of collector. There is little doubt that if properly designed and constructed, the wet method used here is the most satisfactory as 100 per cent. recovery can be obtained. This is impossible with any system of dry collection. The principle employed in the new method of collection depends upon bringing the air and fine sugar into intimate contact with a finely divided water spray. The method of application is shown in the accompanying illustration (Fig. 1). In the upper left hand corner will be noted a row of flooding nozzles directing a mist-like spray over the bank of the eliminator plates set directly below. These eliminators consist of a series of zig-zag galvanized iron plates which effect a change in the direction of air flow passing between them.

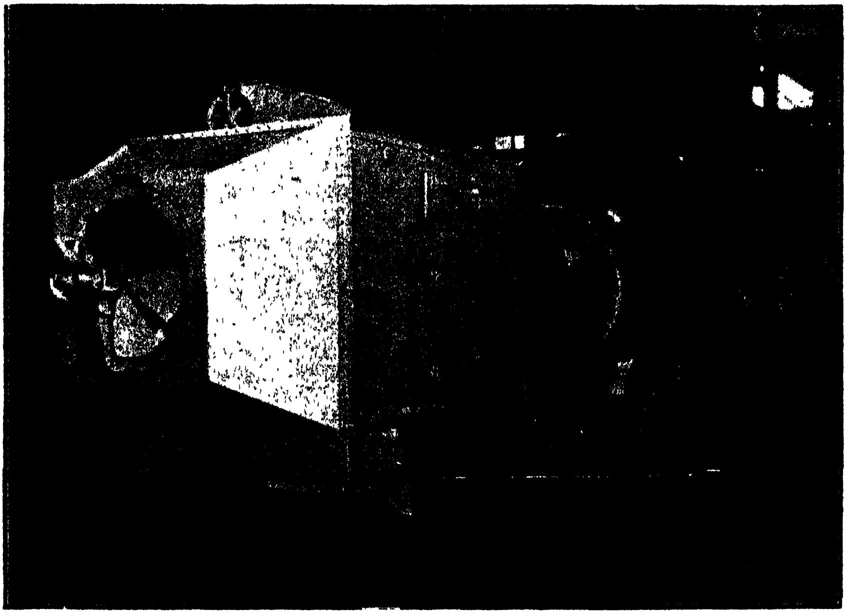

FIG. 2.—EXHAUST CHAMBER END OF BUFFALO SQUIER SUGAR DRYER SHOWING EXHAUST FAN.

The particles of sugar are moistened by this fine spray and the change in direction of air flow due to zig-zag construction causes these moistened particles to strike the surface of the eliminators. Here they meet a thin sheet of water flowing down the surface of the plates and are washed into the tank below. The resulting sweet-water in the tank may be drawn off by an overflow pipe ; this requires a continuous supply of fresh water at the spray nozzles. If desired, however, the water may be used over and over again passing back through the spray nozzles until a certain density (about 30° Brix. or 16·8° Bé.) is obtained. It is then drawn off and passed into the manufacturing process at the most advantageous point. Any of the highly dilute juices in the factory may be used for spray water. Should it be necessary to discontinue the use of this wet system temporarily, the eliminator plates without the use of water continue to reclaim a good portion of fine sugar without additional equipment or power. An angle stem thermometer is placed in the reclaiming chamber which will accurately give the temperature of the air.

Review of Current Technical Literature.[1]

PROBLEM OF THE LOWERING OF THE PURITY OF FINAL MOLASSES IN JAVA. *T. van der Linden. Archief, 1924, 32, No. 5, 107-113.*

Dr. PRINSEN GEERLIGS is here taken to task for his recent article in this Journal,[2] in particular for stating "it is the fault of the present generation that they allow all that sugar to be lost" in the factory molasses in Java. Dr. VAN DER LINDEN (who is a partisan of the solution theory of the formation of molasses) believes that the reason ascribed by Dr. GEERLIGS to account for the presence of fine grain in this product is a wrong one, and that in consequence the motive for the extension of the capacity of crystalliser installations must similarly be in error. He then explains the position according to his views in the following words:—Theoretical and experimental investigation carried out during recent years has furnished the proof that Java molasses is a saturated solution of sucrose which on further concentration (even to higher dry substance contents than can be applied at present in practice) deposits more crystal, the same being the case with longer continued cooling. Proofs of the existence of a minimum purity of grain-free molasses within the present limits of practice are lacking. The result of this is that the lowest grain-free molasses will be obtained with the highest Brix and the lowest temperature, provided no hindrance to crystallization occurs. Any molasses massecuite which is centrifuged at 50°C. or thereabouts (a method of working applied of old in Java, and still used) will furnish a molasses which, after discharging from the centrifugal battery, will deposit sugar crystals, which separate in the form of fine grain. It follows from these principles that any Java molasses centrifuged at a temperature above that of the factory will contain fine grain after a short time. Investigations made at the Experiment Station have established this. The quantity of fine grain which deposits as the result of the lowering of the temperature from 50 to 30°C. was found (in four cases examined) to correspond with a fall of purity from 5 to 10°; and if the massecuite is centrifuged above 50°C., then this amount is still higher. In addition to this constantly occurring cause of the fine grain content of molasses, another is due to the fact that by the rapid cooling of viscous molasses massecuites the separation of false grain occurs. Both increase the fine grain content of the molasses cooled to factory temperature. Until in 1919 KALSHOVEN, using the refractometric method devised by him, announced that this fine grain content averaged about 8 per cent. in Java molasses, nobody had any idea of the quantity of the microscopic fine grain; in fact, it was believed that most molasses with its hardly visible crystals was grain-free.

Dr. GEERLIGS (the author goes on to say) takes cognizance of the discovery of high content in microscopically fine grain, but completely ignores the newer views established by experiment and also in practice, according to which in the cooling of any molasses below the usual temperature of centrifuging (45-50°C.) fine grain must separate. He bases his views only on two causes, viz., injudiciously conducted crystallization and too rapid working. In Dr. GEERLIGS' time the molasses were saturated solutions of sucrose, which, depending on the temperature at which they were centrifuged, likewise must have separated fine grain on standing. On turning up Dr. PRINSEN GEERLIGS' "Handboek," Part III, pp. 414 *et seq.*, where analytical figures are given for 76 molasses, it is there stated that "a number of these molasses contain a little grain which subsequently had crystallized out, the quantity of which is too small to determine." If the Brix of these molasses (which averages 4-5° lower than that of our present product) be considered, then it is clear that a lot of crystallizable sugar must have been present. Dr. GEERLIGS in the article mentioned remarked in regard to the recovery of fine grain, "yet the question is quite a simple one"; but Dr. VAN DER LINDEN insists that its solution in an economic way is not so simple as is thought, and at any rate has not been discovered to date. Concluding his polemics, he protests against blame in this respect being thrown on the present generation of workers in Java, and asserts that, far from this being justified, the present generation should be given credit for discovering the importance of fine grain on the purity of molasses, a discovery which may lead in the future to the lowering of the average purity of this product in an economical way.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1923, 535.

Review of Current Technical Literature.

A Method of estimating the Gripping Quality of Mill Rolls. *E. W. Kopke.* *Sugar News, 1924, 5, No. 4, 196-197.*

A device recently arranged by the writer provides a simple means for measuring the gripping quality of rolls, the readings so obtained practically representing the friction of rest, as the pull is measured which is required to move a small square felt pad ¾ in. thick suitably and uniformly weighted horizontally on the surface of the roll. The pull is, of course, horizontal, and the weight determination is derived by measurement of the extension of a spring which has been previously calibrated as to the equivalent weight corresponding to the stretch. By using a felt pad as the medium for contact with the roll surface, a sufficiently close conformity to the grooving is attained to approximate the actual conditions existing between the cane or bagasse blanket and the rolls at the stage where the feeding difficulties occur. In the following tabulation are stated the grms. of tensions required to move the weighted pad showing the average for a considerable number of observations in different parts of the roll surface. In addition to the average figure, it was considered of interest to include the maximum and minimum figures for each roll. As a certain degree of ambiguity applies to tension values which indicate the force necessary to move the standard test pad, and furthermore, in order to lend additional significance to such values, these determinations have been converted to a basis expressing as 100 a class of surface which has acceptable and very satisfactory feeding characteristics. As a result of a considerable number of tests it was decided that a tension of 425 grms. (friction of rest under these conditions) was a fair figure to accept as 100. The tabulations under this standard are of considerable interest, and, in the estimation of the writer, important.

	TESTS OF ROLL SURFACES.			SURFACIMETER DETERMINATIONS.		
	Pull in Grms.			Frictional Resistance, per cent. of Standard.		
Roll No.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.
1	192	225	156	45	53	37
2	150	156	140	35	37	33
3	291	337	282	68	79	66
4	252	—	—	59	—	—
5	339	380	311	80	89	73
6	364	425	282	86	100	66
7	380	425	366	89	100	86

Device for the Prevention of Jamming in the Use of Revolving Knives in Milling. *J. B. Laing.* *Sugar News, 1924, 5, No. 3, 137-138.*

Ever since the application of revolving knives over the cane carrier mill, engineers have been obliged to contend with no small amount of trouble and delays through the jamming of the knives at peak loads. Various indicating or signalling devices have been tried but these have not given satisfactory service. Independent cane carrier drives which are capable of operating the carrier very rapidly are especially contributory towards jams, as the operator invariably regulates the carrier according to the requirements for a uniform feed, so that he frequently speeds through a light section of cane to the crusher and, unknowingly, at the same time speeds a heavy or peak load of cane into the motor driven knives which are some 50 ft. away enclosed and entirely out of his sight. The revolving (levelling) knife equipment at the factory of the Pampanga Sugar Development Company (Philippine Islands) consists of a set of Hind revolving knives, 43 in., 15-bladed, set 20 in. from the carrier for a normal feed of 60 tons of cane per hour with 11·0 per cent. fibre, and having 490 r.p.m. The drive, direct connected, is a 50 h.p. induction motor, 3-phase, 60 cycles, 60 amperes. The entering of peak loads was formerly signalled to the cane carrier operator, but this was found to be inadequate. Then an alarm bell was connected in such a manner that it would ring when the knives stopped revolving thereby enabling the operator to stop the carrier engine immediately, minimizing the difficulty of clearing the jam. Later an ammeter with an enlarged dial was mounted in front of the carrier operator, so that he could tell at a glance the amount of current being consumed.

This soon became an uninteresting thing to watch, and jams occurred just about the same as ever. Recently, however, the problem was taken up with Westinghouse representatives; and, in accordance with their recommendations there was installed a Time Element Overload Relay, Type C.O., 60 cycles, 2–6 amperes, which was coupled with a 100-ampere transformer. An ammeter was wired in on the same panel for the purpose of checking the load and a 50-watt lamp was hung in front of the cane carrier operator. This lamp was so connected to the overload relay as to cause it to flash when the load had come within six amperes of jamming, which interval of six amperes has been found to be sufficient to enable the carrier operator to retard the rate of feed in ample time to avoid trouble. Since installing this device there has not been a jam, and perfect satisfaction has been realized in its operation and reliability. The total cost of the Overload Relay, transformer, ammeter and connexions was approximately two hundred pesos.

REDUCTION OF FUEL COSTS AT PUUNENE MILL (T. H.). *Report of Committee on Boiler Room Equipment of the Association of Hawaiian Sugar Technologists, 1923.*

During the previous season operations were carried on at the Puunene Mill (T. H.) without the use of oil as an extra fuel, and this was made possible by the following four conditions: (1) Molasses was burnt in conjunction with the bagasse, the burner used being a simple combination of pipes, arranged similarly as for oil burning, and provided with a distributor-head to which the steam and molasses piping was connected. Six furnaces of the regular Dutch oven type were equipped with these burners. A small amount of the bagasse was fed into the furnaces (about one-third that which would be used when firing with it alone), while the molasses was fired through the burner from the front and directly above the fire-box. Live steam was used to atomize the molasses, and exhaust for heating it to a temperature of about 170° F. (75° C.), a pressure of 75 lbs. being maintained at the burner. (2) A change in the bagasse-burning furnace grates were made. Bagasse when fed into the furnace takes the shape of a long thin wedge with the sharp end lying at the top of the step-ladder grates. At this point the layer of fuel is very light, and a good draft quickly removes the fuel from the grates, thereby allowing the air to short-circuit through this space, while the heavier layers of fuel lower down in the furnace remain a smouldering mass until the upper grates become covered again. To remedy this condition, the air spaces between the step-ladder grates were blanked off at the upper end to present dislodgment of the thin layer of fuel at this point. The floor or flat grate area was increased in proportion to the decrease in area of the step-ladder grate. The free space between the floor grates was considerably increased, as was the space under these grates, this being done to present the accumulation of ash under the floor grates from blocking off the air passage-way. This was found to be a great improvement, the bagasse burning freely and evenly, and maintaining a higher and more uniform temperature and record of CO_2. (3) Two 300 h.p. boilers having a combined h.s. of 6345 sq. ft., formerly used with oil burning furnaces were equipped to burn bagasse. (4) Lastly, a great saving of fuel was effected by the adoption of the Petree process and Dorr clarifier, owing to the elimination of the filter-press and mud-press stations.[1]

EXPERIMENTS ON THE CONDITIONS FOR A CONSTANT RATE OF FLOW IN FILTER-PRESS WORK. ***M. B. Donald and R. D. Hunneman.*** *The Chemical Trade Journal and Chemical Engineer, 1923, 708-709.*

This paper[2] describes some work done in the Practice School of the Imperial College, London, to investigate the applicability of the equation developed by W. K. LEWIS expressing the conditions for a constant rate of flow in filter-press work, a Sweetland apparatus being used, and defecated sugar liquor and syrups (molasses) with kieselguhr as an aid. In the case of the sugar liquors, these received fresh kieselguhr, but the syrups or molasses used reclaimed kieselguhr sludge from the sugar liquor presses. The normal operation of the syrup or molasses press was to give the cloth a pre-coat of kieselguhr by running sugar liquor through it for 10 min., after which the liquor was emptied out, and the filter filled with syrup or molasses from the blow-ups by gravity. This was then filtered for 90 min., gradually increasing the pressure to approximate a constant flow. Work done showed that the compression of the sludge was an irreversible effect, i.e., on releasing the pressure the sludge does not return to its original porous state, so that in working a press at constant rate the pressure must be kept well in control. Also that if clear solutions of syrup (previously filtered free from suspended matter) were pumped through the press, the pressure rose with time, and that when coming down from a high rate to a low rate the pressure required for the low rate was much greater than that previously used. This shows that a very small amount of suspended matter is liable to clog up the holes of the filter-cloth and act as a large resistance to the flow of the liquid through it, a principle which is recognised in the case of the syrup liquors by giving the cloth a pre-coat of kieselguhr by means of the sugar liquor. In order to obtain data, one leaf of the Sweetland press, on which the cloth was fairly new, was chosen, instead of the whole filter-press of 72 leaves. A hose was attached to the sight-glass coupling, and this was the source of the filtrate. The over-all pressure on the press was read by a mercury manometer up to 20 lb. gauge, and by a calibrated steam gauge from 12 lb. to the maximum, while pressure adjustment was obtained by means of a hand-valve in the feed line. The press was filled with syrup from the blow-up tank by gravity, so as not to disturb the kieselguhr pre-coat left by the sugar, and when full the gravity line was closed and the pump line opened. The effluent was measured in two ways: A rate was obtained at frequent intervals either by filling a graduated cylinder or by filling a calibrated beaker which rested on a scale pan, the time being measured in each case by a stop-watch. The integration of these rate data should give the total effluent, and this figure was checked by weighing the total effluent in pails. Constancy of flow was obtained by the use of a specially constructed rectangular weir. The hose from the leaf was led into the back compartment of this weir, and the liquor flowed out through a very narrow slit in front. The form of curves obtained for the constant rate should give a straight line according to theory, which, however, they by no means did, and this tended to show that the formula developed by LEWIS would not apply to constant-rate filtration. This formula, however, was designed to disregard press resistance, and, therefore, the press resistance of the initial pre-coat of filter-aid deposited by the sugar liquor must be considerable. The authors show, however, that press resistance must be taken into account, that it can be raised considerably by pumping more or less clear liquor through it, and that it can be modified by giving it a pre-coat of kieselguhr. These facts, they allege, indicate that more attention should be paid in investigations to the initial clogging up of the filter-cloth pores by the precipitate. One of the chief objects of dealing with the problem of filtration in the manner indicated in the paper was to obtain a table of values for the specific resistance for all kinds of materials, and also to ascertain in what way various changes in operation and in method of preparation can affect its value. In this way, it should be possible to design a filter-press from a known constant of the substance to be filtered.

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[1] *Cf., I.S.J.*, 1924, 133.

[2] Read before the Institution of Chemical Engineers on November 14th, 1923.

PITHIVIERS SUGAR FACTORY, ITS "NORIT" REFINERY, DISTILLERY, AND VINASSE (SPENT WASH) UTILIZATION PLANT. *E. Saillard. Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France, Nos. 1816 and 1817 of January 13th and 20th, 1924.*

Pithiviers factory (France), which works up 2000 tons of beets per day, comprises an installation for the treatment of its syrups and molasses by "Norit" for the manufacture of white sugar; a molasses distillery (which also produces yeast); and a plant for the concentration and destructive distillation of the vinasse (spent wash) from the distillery, sulphate of ammonia and nitrogenous products being thus recovered. In this article a detailed account (including a statement of the capacities of the sugar factory apparatus) is given of these activities, from which the following particulars are extracted:—First massecuite strikes are composed of virgin syrup and norited remelt (one-third) with norited first molasses (two-thirds). Most of the first molasses from this strike is boiled to grain on a *pied-de-cuite* of virgin syrup and of norited remelt, the resulting low-product squares being remelted in second carbonatation juice, norited, and used as indicated. In noriting the remelt, which has a density of 26° Bé., the procedure is to treat each 80 hl. tank with 315 kg. of the fresh or regenerated carbon, to heat to 90–95°C., to mix for 30 min., and to filter, first through presses and then through Philippes, the cake being washed with hot water and used for the treatment of the first molasses, which is effected in a similar way to the remelt. Regeneration of the "Norit" is carried out by boiling with sodium carbonate solution, followed from time to time by reburning. A close chemical control was applied by M. SAILLARD during his investigations of these operations, and the following figures summarize some of the results obtained by him with products before and after noriting :—

	REMELT.		MIXED MOLASSES.	
	Before Treatment.	After Treatment.	Before Treatment.	After Treatment.
Sugar	53·00	50·43	48·70	46·30
Solids (true)	56·00	53·16	61·3	56·9
Ash	1·03	0·94	4·27	3·60
Purity (true)	94·6	94·8	79·4	81·3
Saline ratio	51·4	53·6	11·4	12·86
Organic matter/ash	1·91	1·90	1·95	1·94
Viscosity (rate of flow of 200 c.c. in min. and sec.)	2·39	2·35	4·24	4·5
Decolorization, per cent. original	100	50	100	83

Lime was removed only to an insignificant extent, but the elimination of nitrogen was 10–12 per cent. for the remelt, though much less for the molasses. It was remarked that the boiling of the products treated with "Norit" was much easier.

THE MUDDY JUICE PROCESS IN THE BEET FACTORY.

(1) *M. Haase. Centralblatt für die Zuckerindustrie, 1924, 32, No. 23, 344.* (2) *H. Claassen. Ibid., 1924, 32, No. 23, 344.*

(1) In the so-called "muddy juice process," a definite quantity of the unfiltered juice from the first carbonatation is returned to the diffusion juice measuring-tanks, a certain saving in lime and also it is claimed in coal being thereby realized, which process is said to be particularly useful when working with frozen roots. It is pointed out here that the return of scums in this way is by no means new, since the author practised it in 1918-19. It is stated to have a wonderful effect in facilitating the carbonatation scum press work, as indeed may very easily be proved. All that it is necessary to do is to add a pipe branching from the pressure line between the muddy juice pump and the pre-heaters for the first presses, this pipe delivering into the diffusion juice measuring-tanks. Previous to each draw-off, about 20 per cent. of the muddy juice is run into the measuring tank which is filled with the diffusion juice, and the mixture subsequently treated with lime according to its alkalinity, a less quantity than ordinarily is used sufficing. Some of the results observed when operating this process are stated to have been as follows :—

	NORMAL OPERATION. Per cent. roots.	USING MUDDY JUICE PROCESS. Per cent. roots.
Limestone used for the milk-of-lime	3·75	2·64
Actual CaO used for liming	2·10	1·47
Scums produced	8·81	6·24

In the factory in which the process is being operated the lime was added in the form of milk at 20° Bé., and by being able to reduce the CaO requirements from 2·10 to say 1·50 per cent. of the roots the amount of water necessary for making this milk was reduced in 24 hours from 975 to 696 hl., the difference of 279 hl. corresponding to an economy of coal amounting to 55 dz. daily.

(2) In this paper Dr. CLAASSEN criticises certain points in Haase's contribution. Firstly it was stated that the alkalinity of the juice after it had been mixed with the mud, and filtered, averaged 0·70 per cent. CaO, whereas that of normal juice was 0·25 to 0·30 per

cent. But it is pointed out that the soluble lime content of the juice depends on the temperature, so that at 48° C. one may find an alkalinity of 0·70 per cent., and at 70-80°C. only 0·25 to 0·30. Secondly, in regard to the calculation of the coal economy, it was stated that there were 27,900 litres of water less to be evaporated, and that this corresponds to 5500 kg. of coal. This figure would only be correct if evaporation were performed in in one stage, but at multiple effect the coal economy would be one-third or one-quarter of the amount stated, depending on whether a triple or a quadruple effect were used.

DIFFERENCE BETWEEN THE DIRECT AND DOUBLE POLARIZATIONS OF BEET MOLASSES. *E. Saillard. Supplément à la Circulaire du Comité Central des Fabricants de Sucre de France. No. 1922, February 24th, 1924.*

In the case of beet molasses (containing no reducing sugars), the direct polarization is always higher than the figure given by the double polarization method, applying either the original Clerget or the Herzfeld modification, which difference is not constant, but varies from one factory and from one year to another. It is of interest to investigate the causes of the variation of the difference, whether it is the nature of the roots sliced, the method of working in the factory, or some other reason which has not been elucidated. Mr. SAILLARD each year carries out a good number of analyses of molasses from different factories in France, determining not only the sucrose and dry substance, but also the nitrogen, and therefore he is in possession of data which may assist in the solution of the question. As the result of examining this "documentation," he has observed that the difference in question decreases as the nitrogen content of the molasses increases, and that the molasses from dry campaigns contains more nitrogen (per cent. dry substance) than the product of ordinary or of wet seasons. Thus in the year 1911-12, an abnormally dry one, the difference between the direct and the double polarizations reached a minimum, disappearing entirely or almost so in the case of certain molasses. On the average, however, the difference was 0·53 per cent. with a nitrogen content of 2·65 per cent. of the dry substance; whereas in the year 1912-13 the values were 1·45 and 2·08 per cent. Another fact revealed by a study of the data on hand is that the difference in question gradually increases in any factory during the campaign. Thus, the initial and final differences observed in four factories were: 1·75–2·10; 1·20–1·83; 1·02–2·31; and 0·40–0·56.

CALCULATION OF THE RATE OF FORMATION OF SCALE IN EVAPORATORS, PANS, ETC. *W. L. McCable and C. S. Robinson. Industrial and Engineering Chemistry, 1924, 16, No. 5, 478-479.*

It is assumed that under constant operating conditions with respect to liquid velocities and temperature difference, and where the feed enters the evaporator at about boiling temperature, the amount of scale deposited on the heating surface is directly proportional to the amount of water evaporated. Since the water evaporated is proportional to the heat flow through the heating surface, the following relation may be written: $S = aQ$ where S is the thickness of the scale (for thin deposits only), Q is the heat which has passed through the heating surface, and a is the proportionality constant. Based on this formula, a relation is deduced between the coefficient of heat and the time, and its validity is tested by data obtained by KERR[1] on a quadruple effect Kestner evaporating juice at Guanica Central, these data being plotted.

CHEMISTRY APPLIED TO THE MANUFACTURE OF CONFECTIONERY. *H. S. Paine. Industrial and Engineering Chemistry, 1924, 16, No. 5, 513-517.*

In this article, a contribution from the Carbohydrate Laboratory, Bureau of Chemistry, Washington, the commercial process for manufacturing fondant types of confectionery is described from the scientific standpoint. Also, the author outlines the considerations which have led to the successful use of the enzyme *invertase* on an extensive scale by some of the largest confectionery manufacturers in the U.S.

J. P. O.

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[1] *Bulletin 149, La. State University.*

Review of Recent Patents.[1]

UNITED KINGDOM.

POLARISCOPES (SACCHARIMETERS). *Adam Hilger, Ltd., and P. R. Ord,* of 75a, Camden Road, London, N.W. *214,712.* January 23rd, 1923.

Polarimetric apparatus for measuring the rotation of the plane of polarization of a substance is constructed so that the analyser, of the kind dividing the field into two parts, has its dividing line at the focus of the eyepiece, the position being unaffected by the introduction into the apparatus of the substance to be tested. Rays of light from a source a are rendered parallel by a lense b and pass through a filter c of potassium bichromate to a Nicol prism d and from thence through the tube f containing the liquid to be examined. At the eyepiece end of the instrument are situated two Nicol prisms h, which may be adjusted as described in Specification 166,842,[2] and two inclined plates i, all mounted in the casing k. The prisms h and plates i are adjusted so that a sharp dividing line is maintained at the focus of the eyepiece j. A screw l is fitted for rotating the prisms h to set the zero position of the scale m which is provided with a vernier n and viewed through a lens o. Reflectors p are fitted for the illumination of the scale m. In use the polarizer d is rotated and the analyser is stationary.

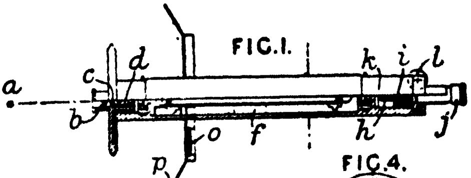
FIG. I.

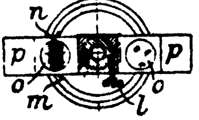
FIG. 4.

WEIR APPARATUS FOR MAINTAINING AN EVEN FLOW OF DILUTE JUICE IN MACERATION. *Duncan Stewart & Co., Ltd.,* of London Road Iron Works, Glasgow, Scotland; and *William Kilpatrick,* of the same address. *213,857.* November 15th, 1923.

This invention has for its object an apparatus for maintaining an even flow of liquid containing matters in suspension over a length of weir lip during the transference of the liquid from one machine or apparatus to another, and keeping at the same time suspended matters in uniform mixture. It may be used for transferring, for example, the dilute juice from the last unit of a train of mills to a previous unit where the dilute juice containing a large proportion of finely divided cane fibre or "cush cush" is required to be evenly distributed over the bagasse on its way to a succeeding unit of the mill train. An apparatus made according to the invention comprises essentially a semi or partially cylindrical trough having an upstanding wall at one side, a cover extending over substantially half its width at that side, and at the other side a weir-like lip which may extend for the whole or for a part of its length. Within the trough is mounted upon a horizontal axis a drum longitudinally fluted, grooved or faceted with the higher parts of its periphery closely adjacent to the cylindrical surface of the trough. This drum is constantly driven from an extraneous source. Referring to the drawing, over the weir A^3 a uniform flow of liquid is maintained by means of a driven fluted or faceted drum B running in a trough A. A cover A^2 extends over half the width of the trough and the fluid is admitted through it by a pipe A^4. The weir lip may be serrated. To bring the fluid to a relatively narrow weir-lip, the fluting on the drum may be helical or double helical.

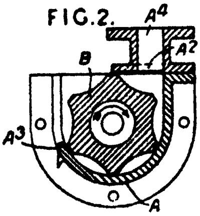
FIG. 2.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

[2] *I.S.J.*, 1922, 105.

Production of Active (Decolorizing) Carbon. *Algemeene Norit Maatschappij (General Norit Co., Ltd.)*, 2, Den Texstraat, Amsterdam, Holland (assignees of *J. N. A. Sauer.*). *213,935.* January 13th, 1923; convention date, May 26th, 1922.

A process for producing active charcoal, of the type in which a carbonaceous material is heated in the presence of activating gas or gases, is characterized in that the raw material, which may be uncarbonized, carbonized, or partially carbonized such as coal, brown coal, or coke produced by the low temperature carbonization of dense peat, previously reduced to granular form, descends in thin layers through a retort which is internally and/or externally heated. The activating gases specified are steam (preferably superheated), carbon dioxide, air, hydrogen, flue or generator gases, hot gases of combustion, or burning gases or combustible gases. Chlorine and sulphur dioxide may be used to remove inorganic impurities. The gases may be introduced separately each into a zone maintained at the optimum activating temperature for the gas, or may be mixed and the whole passed through the separate zones. The process may be carried out in a vertical or inclined retort having zig-zag channels, so that the gases introduced at the top pass over the thin layers of the charge. The finely powdered finished product may be separated from the retort gases by cooling them and spraying them with water or steam, or passing them through water.

Revivification of Active (Decolorizing) Carbon. *Algemeene Norit Maatschappi' (General Norit Co., Ltd.)*, 2, Den Texstraat, Amsterdam, Holland (assignees of *J. N. A. Sauer*). (*A*) *213,939.* January 13th, 1923; convention date, May 26th, 1922. (*B*) *213,940.* January 13th, 1923; convention date, May 26th, 1922.

(*A*) Granular activated carbon, which has absorbed organic matter, is revivified by being subjected to the action of heat and activating gases while being mechanically agitated, the organic matter being thereby carbonized and finally consumed. The heating of the drum or chamber used for regeneration may be internal, such as by injection of hot or burning gases, external, or both. Gases such as chlorine and sulphur dioxide may be used to remove inorganic impurities. The Specification as open to inspection under Sect. 91 (3) (a) describes a process in which the action of the gases is limited to the carbonization of the organic matter and the activation but not complete consumption of this secondary carbon. This subject-matter does not appear in the Specification as accepted.

(*B*) Granular activated carbon, which has absorbed organic matter, is revivified by being subjected to the action of heat and activating gas while in a state of flotation in a blast of gas, the organic matter being thereby carbonized and removed. The retort may be heated internally, as by injection of hot or burning gas, externally, or both, and may be horizontal or vertical. The blast may be activating gases with or without an inert gas. Gases such as chlorine or sulphur dioxide, may be used to remove inorganic impurities. The Specification as open to inspection under Sect. 91 (3) (a) describes also a process in which the action of the gases is limited to the carbonization of the organic matter and the activation but not complete removal of this secondary carbon. This subject-matter does not appear in the Specification as accepted.

Dehydrating Alcohol. *E. C. R. Marks (U.S. Industrial Alcohol Co.*, of New York). *213,984.* January 11th, 1923. *213,985.* January 11th, 1923.

In obtaining water-free alcohol, it is distilled in a rectifying column in the presence of a liquid miscible with alcohol but substantially immiscible with water, such as benzol, carbon tetrachloride, ethyl acetate, etc.[1] Water free-alcohol is obtained as residual liquid from the base of the column, and the vapours from the top are treated to yield a constant boiling mixture of alcohol, water and added liquid, which is treated to separate the constituents.

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[1] Compare U.K. Patent, 206,747; *I.S.J.*, 1924, 283.

PREPARATION OF MOLASSES CATTLE FOOD. *Molassine Co., Ltd.*, of East Greenwich, London; *H. C. Davies,* and *H. C. S. de Whalley.* *209,987.* March 12th, 1923.

In the manufacture of food for animals from cane molasses mixed with sphagnum peat moss, the molasses is sterilized by heating it to 180° F. for about half-an-hour, and is then added hot to a comparatively small proportion of ground peat-moss, and rapidly cooled. Tribasic phosphate of lime and common salt may be added, and beet molasses may be mixed with the cane molasses, the potash salts in which assist sterilization and reduce the period of heating.

ALCOHOL MOTOR FUEL CONTAINING ETHER AND ACETYLENE. *G. Henneberg and M. Charpentier.* *213,526.* September 21st, 1923; convention date, March 27th.

A fuel for lighting, heating, and power purposes consists of a solution of acetylene in acetone and dehydrated alcohol. Ether and ammonia may be added. Suitable proportions are 93 to 95 litres of 99 to 99·7 per cent. alcohol, 1 to 2·5 litres of acetone, 6 to 10 litres of acetylene, 2 to 4 litres of ethyl ether, and 0·3 to 0·5 litres of ammonia solution of 28° Bé. (scale lighter than water). Apparatus for the production of this fuel is described.

EVAPORATOR FOR CONCENTRATING LIQUORS TO HIGH DENSITIES. *Archibald Blair; and Blair, Campbell & McLean, Ltd.*, of Govan, Glasgow, Scotland. *208,247.* September 20th, 1922.

Liquors are concentrated to high densities by passing them at a high velocity through the tubes of a calandria having one or more sets of parallel tubes all arranged to lie horizontally, each set comprising one or more tubes, the high velocity of the liquor being obtained by the vapour generated in the tubes and the pressure or head whereby the liquor is fed into the tubes. According to a preferred construction of apparatus, the calandria is provided with sets of parallel tubes communicating with headers, each set consisting of one or more tubes, all said tubes lying horizontally. The headers may be in the form of caps or compartments, each of which covers the one or more tube ends of the tubes carrying the liquor in the one direction, and also the one or more tubes carrying the liquor in the opposite direction. Or the ends of the liquor tubes may be connected together by bends giving an unbroken flow to the liquor when making the return, such bends being enclosed by caps connected directly to the jacket or casing of the main horizontal vessel, thus giving an entire jacket of steam from end to end of the complete liquor travel in the complete apparatus. A liquor supply inlet is provided at the one end of the travel and a pump or other means provided to feed the liquor thereto.

BEET HARVESTER. *A. Bailey and W. Kelly,* of Ottumwa, Iowa, U.S.A., *214,147.* July 30th, 1923.

A beet topping device for attachment to a beet harvester, of the type having pivoted converging arms that direct the tops to cutting means at the rear, is provided with means positioned between the converging arms to engage the beet tops to effect adjustment of the height of the arms and the cutting means.

GERMANY.

PRODUCTION OF A HIGHLY ACTIVE (DECOLORIZING) CARBON. *Rhenania Ver. Chem. Fabr. A. G. Zweigniederlassung Mannheim.* *386,519.* February 28th, 1922.

A two-stage process of heating in the manufacture of decolorizing carbon is disclosed in this patent. Cellulose, lignite, or other suitable organic material is mixed with potassium hydroxide or potassium carbonate or the like, and the whole gently heated to remove most of the water present. It is then heated more strongly, so that partial gasification occurs, and finally placed in a high temperature oven and thoroughly calcined. Waste heat from this latter operation suffices for the preliminary gasification, while there is a saving in the number of high temperature ovens, as compared with those required when the whole of the heating is effected in one operation.

UNITED STATES.

Treatment of Juices, Syrups, etc., with Decolorizing Carbon, Kieselguhr, etc., and the Separation of these Latter by a Self-Cleaning Filter. *Charles D. Morton* (assignor to *Morton Filter Process Co.*, of New York, U.S.A.). *1,450.560.* April 3rd, 1923.

The fundamental purpose of the invention is to secure the admixture of the decolorizing carbon or other adsorptive reagent with the juice, syrup, etc., and then to remove this reagent by a rapid filtration without the formation of any cake. Turning to the drawings (Fig. 1), the tank *11* is partially filled with the carbon or kieselguhr (indicated by *a*), while the fresh juice or syrup is introduced by way of the pipe *12*, the pump *13*, the pipe *15*, and the nozzle *16*, by which latter the solid matter is kept in intimate admixture, the temperature of the reaction being maintained by means of the heating coils *17*. After this treatment, the liquor is discharged through *18* to pipe *19* and the circulating pump *22*, by which it is forced through the filter-heads *31a*, *31b*, and *31c*, any or all of which may be by-passed by way of pipe *33* and the valve arrangement shown.

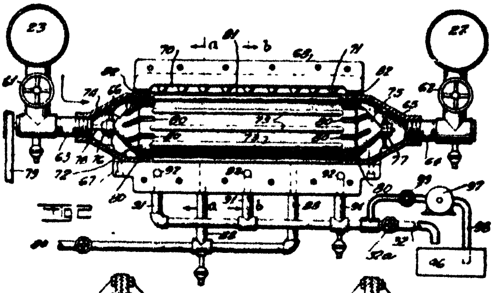


Fig 2

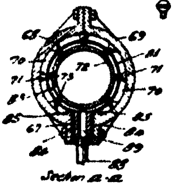


Fig 3

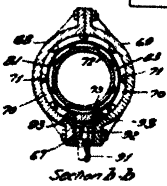


Fig 4

The filter-head is of a novel type (shown in detail in Figs. 2, 3, and 4). It consists of a reducing coupling *66* connecting to pipe *63* leading to header *23* and reducing coupling *65* connecting to pipe *64* leading to header *27*, these couplings being connected by the separating plate *67*. The filter-cloth *81* is wrapped around couplings *65* and *66* with the sides terminating against plate *67* as shown, and is tightly clamped in position by the split casing *68* and *69*. This casing is made to seal the filter-cloth against the couplings and the plate *67*. Pads *82* may be used between the filter-cloth and the casing as shown to obtain a better sealing effect. An annular space *70* is provided between the casing and the filter element or cloth *81*, and a series of spaced bosses *71* formed in the casing project across this space to act as a support for the filter-cloth. In order to hold the cloth to the contour of the couplings, the ridges *85* are provided on each side of the casing engaging plate *67*. The casing may be secured in position by clamping bolts or other suitable means, and is readily removable for the purpose of removing the filter-cloth. A drum *72* is provided in the interior of the filter-head, preferably provided with conical ends *74* and *75*. This drum may be mounted for rotation in the bearings *76* and *77* secured to the reducing couplings, and a driving shaft *78* may extend from this drum through a stuffing box in pipe *63* to a pulley driven by belt *79*. This enables the drum to be rotated mechanically if the nature of the liquid should make this desirable, or it enables an index to be attached to the drum to show that it is rotating. The drum is provided with a series of ridges or corrugations *73* which pass quite close to the filter-cloth. The ends of the drum are provided with grooves *80* placed spirally on the cones *74* and *75* and terminating between the ridges *73*. When the liquid is forced through pipe *63* in the direction indicated by the arrow it strikes the cone *74* and through the grooves *80* enters the space between the ridges *73* indicated by *83* (Figs. 3 and 4). The flow of the liquid acting on the spiral grooves causes the drum to revolve, and the centrifugal action set up thereby causes the film of liquid in space *83* to be forced against the filter-cloth *81*. This is additional to the force it may receive from the pressure of the circulating system.

Independent connexions are made to the inside and to the outside of the filter-cloth through plate *67*, these connexions are thus a fixture with this plate and do not have to be removed when the filter-cloth is changed. As best shown in Fig. 3, pipe *88*, which is connected to plate *67*, communicates with a passage *89* leading to space *83* inside the filter-cloth *81*. As shown in Fig. 2, pipe *88* is connected to pipe *90*. As shown in Fig. 4, pipe *91* connects by passage *92* and passages *93* with space *70* on the outside of the filter-cloth. Pipes *91* lead off by connexion *32* to tank *96*. Drip cocks may be provided where necessary for testing purposes. A vital characteristic of the present invention is the prevention of the formation of a cake by the continuous flow of the liquid through the narrow channels *83* acting to clean the filter surface, and by the agitating action of the ridges *73* as the drum is rotated also continuously cleaning the filter surface.

Even though no cake, as such, forms, the meshes of the cloth will ultimately become clogged by gums, pectins, and other slimy or colloidal substances which tend to follow the filtrate. These may be washed out by reversing the flow through the cloth. A similar result may be had, without interrupting the circulation through the tank and filter head, by temporarily applying through pipe *32* a pressure greater than that existing in the circulating system.

PRESSURE APPARATUS FOR JUICE AND SYRUP FILTRATION, OR FOR THE SEPARATION OF DECOLORIZING CARBON, ETC. *Rafael Vachier*, of Baton Rouge, Louisiana, U.S.A. *1,438,797*. December 12th, 1922.

A represents the filter tank in which the various filter-leaves and the parts co-operating therewith are mounted. This filter tank is preferably provided with a rounded bottom *a* and vertical sides a^1 flanged at the top, as at a^2. One of the ends of the filter tank is closed with a plate A^2, slotted to permit the insertion of a tubular shaft *E*. The other end of the tank is closed with a plate A^1, and the top of the tank is securely closed against pressure by means of the cover *B* and *C*. Any suitable packing could, of course, be used. The slot a^0 of the end plate A^2 may be closed in any convenient way, as by means of the gate *D* and securing members D^1. The tank may be supported by suitable feet A^3, and also provided with longitudinal plates mounted exterior to and along the sides thereof, as shown at A^4 and A^5. The tubular shaft *E* is connected, as by means of the pipe *F*, shown in the dotted lines in Fig. 2, to any suitable source of water supply described. The other end of this tubular shaft is closed, as at *e*, and this closed end carrying a gear wheel E^1 which meshes with a pinion *G* on the stub shaft G^1. This stub shaft may be driven in any suitable way, as by means of a pinion and belt G^3. Mounted on the tubular shaft *E* are a series of filter leaves *H* which consist of U-shaped frames H^1 to which are attached foraminous sheets H^2 H^3 (Fig. 10) made of suitable fine-mesh metal wire or perforated metal, which is not apt to corrode, such as certain well known nickel alloys. In

Fig. 2.

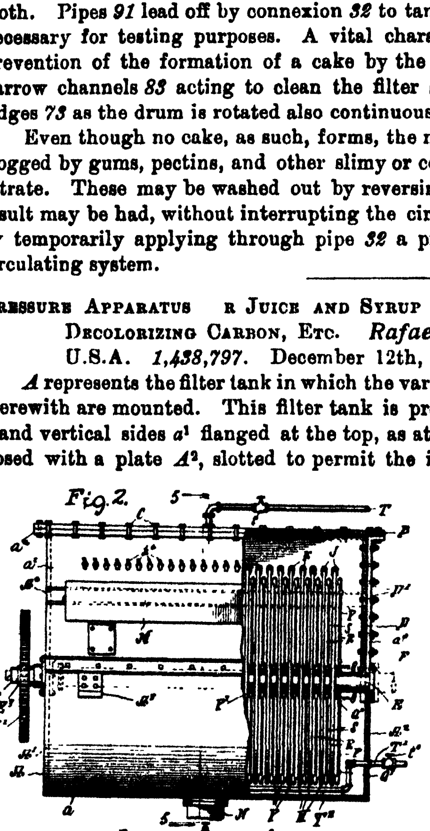


Fig. 3.

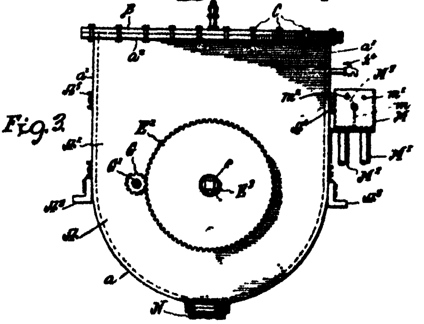
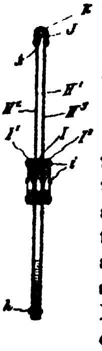


Fig. 10



order to slide these onto or remove the same from the tubular shaft E, there are central bearings, which comprise the middle ring I and the outer rings I^1, which are connected together by the bolts or rivets i and form a tight joint with the edges of the sheets H^2 and H^3. The individual leaves are connected at the top by the butt plates J to the pipes K, which are perforated at their bottom, as at k, with one end closed and the other end open, and screw-threaded to receive a cock. Thus any liquid forced between the foraminous sheets H^2 and H^3 will tend to flow up into the pipe K, and may be drained off through the cock. On the exterior of the tank, is provided the trough M to receive the filtered liquid, which trough is preferably provided with a partition m, separating it into two troughs, one of which is drained by the pipe M^1 (see Fig. 3), and the other of which is drained by the pipe M^2. The liquid may be deflected from the various cocks k^4 into either side of the partition m by means of a suitable deflecting plate M^3, which may be turned to engage either one or the other of the stops m^1 or m^2. The tubular shaft E is provided with a series of screw-threaded openings to engage the screw-threaded ends of the spray pipes P, which pipes are adjustably mounted in place by means of nuts. These spray pipes P are provided with a series of spray openings, and fastened to these spray pipes are brackets secured to the pipes P by the straps and bolts. These brackets carry the scraping blades R and S, and the pipes P with the brackets and the blades R and S are rotated between adjacent leaves in either clockwise or anti-clockwise direction. Each filter unit is provided with a manifold N at the bottom thereof which may be used for charging or for emptying the filter tank, or for washing out same. Compressed air may be supplied to the upper part of the filter tank by means of the pipe T controlled by the valve t and, similarly, compressed air may be supplied to the lower part of the filter tank by means of the branch pipe T^1, controlled by the valve t^0, and perforated branches T^2, as shown in Fig. 2. Following this a complete apparatus for filtration, in which the above filter forms a unit, is described.

PROCESS OF REFINING, USING ALCOHOL AND DECOLORIZING CARBON. ***Roy D. Elliott***, of Crockett, U.S.A. *1,476,242.* December 4th, 1923.

Sugar liquor (e.g., that obtained from re-melting washed crystals, or that resulting from the concentration of the filter-press and char-filter wash-waters, or syrup or molasses) is brought to a suitable density (35 to 65° Brix) and temperature (10 to 35° C.), and to it is added from 1 to 1½ volumes of 90–96 per cent. alcohol (denatured or partly denatured), and after stirring from 1 to 3 per cent. of decolorizing carbon (of the weight of the sugar solution), stirring being continued, using an air jet or other suitable means. Mineral substances (principally calcium sulphate) are thus precipitated, and gummy matters are taken up by the carbon. Filtration through a plate-and-frame press follows, and the cake washed first with 93–96 per cent. alcohol, and then with water; while the alcoholic solution of sugar leaving the filter is treated with a potash precipitating substance, e.g., aluminium sulphate, or tartaric acid and its salts, the potassium compound thus separated being filtered, washed, and dried, and packed for market. Excess of the potash precipitant is removed by means of lime, and a further quantity of decolorizing carbon, that is, 1 to 3 per cent. (as before) is stirred in during a few minutes, filtered off, and the cake washed as before described. Excess of lime is next removed by means of a suitable reagent, e.g., phosphoric acid, calcium phosphate, carbon dioxide, etc., the addition being arrested at a point at which the reaction is barely alkaline to litmus paper, after which another 1 to 3 per cent. of decolorizing carbon is added. After treatment in the manner outlined above, and after removing the alcohol by distillation in a suitable apparatus, a solution of sugar is obtained which is "practically free of all organic and mineral impurities deleterious to the concentration of the solution and the crystallization and purging of the sucrose," the formation of final molasses being thus prevented, though a residual syrup suitable for table use may result. The decolorizing carbon used at three stages in the process described above is made by the destructive distillation of the alcohol precipitate from the sugar liquor, the carbon produced being added to the impure sugar liquor, filtered off, washed, and re-carbonized.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th.		Six Months ending June 30th.	
	1923. Tons.	1924. Tons.	1923. Tons.	1924. Tons.
Unrefined Sugars.				
Poland	859	....	5,470	21,076
Germany	....	....	1	.
Netherlands	14	....	14	....
France	....	. ..	....	....
Czecho-Slovakia		....	.	...
Java	5,316	5,084	18,508	22,028
Philippine Islands	....	....	...	....
Cuba	49,500	12,871	232,967	261,454
Dutch Guiana	....	....	...	....
Hayti and San Domingo	596	16,240	34,983	81,416
Mexico	....	....	....	....
Peru	2,136	3,254	52,560	49,274
Brazil	13,072	....	67,826	21,336
Mauritius	5,514	3,235	130,487	93,442
British India		....	....	....
Straits Settlements	....	...	....	....
British West Indies, British Guiana & British Honduras	23,514	7,415	75,720	48,391
Other Countries	8,201	10,961	28,121	75,717
Total Raw Sugars	**108,722**	**59,060**	**646,657**	**674,133**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	4,398	5,869	27,890	89,087
Belgium	824	121	10,084	19,916
France	....	....	235	....
Czecho-Slovakia	7,532	30,465	66,776	134,587
Java	....	....	....	....
United States of America	33,757	10,176	88,054	37,153
Canada	13,667	4,054	24,470	17,084
Other Countries	2,282	4,270	25,392	22,950
Total Refined Sugars	**62,460**	**54,956**	**242,902**	**320,778**
Molasses	7,119	30,522	77,994	103,622
Total Imports	**178,301**	**144,538**	**967,553**	**1,098,533**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	78	20	523	198
Netherlands	91	37	839	177
Irish Free State	3,859	3,909	12,974	23,882
Channel Islands	20	72	541	514
Canada	....	...	....	....
Other Countries	368	655	3,706	3,347
	4,416	4,694	18,584	28,119
Foreign & Colonial Sugars				
Refined and Candy	917	95	2,682	671
Unrefined	23	21	10,270	4,985
Various Mixed in Bond	....	....	....	....
Molasses	190	23	1,932	1,230
Total Exports	**5,546**	**4,833**	**33,468**	**35,005**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to June 25th	1.801,101	..	1,835,351
Deliveries „ „	1,733,284	..	1,828,816
Meltings by Refiners „ „	1,589,910	..	1,662,560
Exports of Refined „ „	77,000	..	160,000
Importers' Stocks, June 25th	68,611	..	6,535
Total Stocks, June 25th	224,424	..	173,310
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.		1922-23. Tons		1923-24. Tons.
Exports	1,875,214	..	2,357,833	..	2,231,001
Stocks	1,022,255	..	669,543	..	929,239
	2,897,469		3,027,376		3,160,240
Local Consumption	62,500	..	52,500	..	50,000
Receipts at Ports to May 31st	2,959,969		3,079,876		3,210,240

Havana, May 31st, 1924.

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1922, 1923, AND 1924.

IMPORTS.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined......	256,050	..	242,902	..	320,778
Raw	781,700	..	646,657	..	674,133
Molasses ..	53,204	..	77,994	..	103,622
	1,090,954		967,553		1,098,533

EXPORTS (Foreign).

	1922. Tons.		1923. Tons.		1924. Tons.
Refined........	1,248	..	2,682	..	671
Raw.....	6,595	..	10,270	..	4,985
Molasses	899	..	1,932	..	1,230
	8,742		14,884		6,886

HOME CONSUMPTION.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined	232,866	..	198.227	..	263,911
Refined (in Bond) in the United Kingdom	467,184	..	463,223	..	460,030
Raw	84,853	..	71,159	..	49,863
Total of Sugar	784,903		732,609		773,804
Molasses..	4,229	..	5.311	..	3,711
Molasses, manufactured (in Bond) in United Kingdom ..	26,479	..	28,873	..	29,614
	815,611		766,793		807,129

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT JUNE 30TH, 1924.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined in Bond	43,900	..	59,450	..	48,550
Foreign Refined	33,250	..	73,100	..	76,750
„ Unrefined..	283,450	..	259,100	..	184,400
	360,600		391,650		309,700

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th June, 1924.

The market generally has recovered from its depressed condition and has maintained a steady to firm tendency throughout the period under review, and prices for all classes of sugar are about 2s. per cwt. higher than the lowest quotations recorded.

The terminal market has fluctuated within narrow limits and the business passing has been remarkably small for this period of the year. Speculators have been busy liquidating their August commitments, and at one time August recovered to 23s. 10½d. only to decline to 22s. 1½d. From this point the market hardened to 23s. 9d , but relapsed again to 22s. 9d. There was only a small quantity of June tendered, and this month was finally liquidated at 23s. 6d. New crop has not been in much favour, and nervous holders have been realizing. Prices at one time recovered to 20s. 6d. for December and March, but at the moment they are at the lowest point touched for new crop. The latest prices are: August, 22s. 7½d.; December, 19s. 1½d.; March, 19s. 3d.

Trading in actual sugar has been brisk, and buyers have recovered sufficient confidence to realize that their stocks were small and that prices were reasonable. A large trade has been done in spot sugars, principally in London where, owing to speculators who had accumulated large stocks trying to liquidate their holdings, prices were 1s. 6d. to 2s. per cwt. below the parity elsewhere. The natural effect of this was for London to feed districts that normally draw their supplies from other big ports, and also to encourage the export of sugar to foreign countries, such as Spain, Russia and Brazil, etc.

The British refiners have maintained a very steady attitude throughout, and whilst the alterations made in their prices have been few, they have all been in the upward direction. On June 17th their prices were advanced 6d. all round, on June 25th Granulated was advanced 6d. and Cubes 9d., and on June 27th Granulated was again against 3d. and Cubes 6d., making the total advance for Granulated 1s. 3d. and Cubes 1s. 9d. To-day's quotations are: No. 1 Cubes, 42s. 6d.; London Granulated, 38s. 10½. A few thousand tons of the British Refined was also exported from London to Spain.

Business done in raws to the British refiners has been small. Transactions have taken place in Cubans from 18s. to 19s. 6d. c.i.f., some San Domingos sold at 18s. 9d. c.i.f., and No. 17 Javas at 19s. 6d. c.i.f. The latest price for raws is 19s. c.i.f.

Foreign Refined has been active and the demand has been good. There is no further sugar offering from Czecho-slovakia, and a bear a/c has manifested itself in Czecho Granulated for June and July and transactions took place from 24s. to 26s. 9d. f.o.b. A good first-hand business, however, has been done in preserving sugar. Dutch sugars—owing to the scarcity of Czecho makes—have fetched relatively good prices and were sold from 23s. 6d. to 25s. f.o.b. American Granulated has only been sparsely dealt in at prices ranging from 24s. to 26s. c.i.f. Germany, who had sold largely, withdrew for a time, but on the grant of permission to export a further 50,000 tons German Granulated came on offer again, and was sold at 24s. to 24s. 1½d. f.o.b. White Javas have been a good market, and the East have been continual buyers and about 40,000 tons were sold back from the U.K. May/June was sold at 20s. 3d. to 22s. 9d. c.i.f.

The spot market has been firm and a large business has been done in Fine Granulated from 35s. to 37s. duty paid, and lower grades from 34s. to 35s. 6d. duty paid.

The American market has remained comparatively steady throughout the period, and the demand for Refined caused the refiners to make large purchases of raws which Cuban holders were quite willing to meet. Cuban 96 per cent. fluctuated between 3 and 3½ cents, the latest price being 3¼ cents c.i.f. New York.

No further estimates have been brought out with regard to Cuba, and a crop of 4,000,000 tons is now practically assured.

The weather in Europe has been normal for the growing crops, and should conditions continue favourable until the harvest, an increase of 1,500,000 tons is considered quite possible.

21, Mincing Lane,
London, E.C. 3.
July 10th, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 308. AUGUST, 1924. Vol. XXVI.

Notes and Comments.

Government Aid for the Home Beet Industry.

The Government have taken a long time to make up their minds whether they would continue to give the home beet sugar industry their support, and if so in what form. But as they have converted Mr. SNOWDEN, the Chancellor of the Exchequer, from being a lukewarm critic of the project to an enthusiastic supporter, the time has certainly not been ill-spent. It is perhaps as well not to enquire too minutely how the conversion was effected; there is no doubt that the Cabinet as a whole have been firmly impressed with the merits of a home beet sugar industry, and see in it a legitimate prospect of decreasing unemployment in the rural constituencies (where Labour will have to make some headway if it is ever to command a clear majority in the House of Commons). But while orthodox Free Traders (to which body Mr. SNOWDEN is supposed to belong) have not in the past exhibited any objection to sugar bounties given in other countries when the net result was supposed to benefit us, one was not prepared for their sanctioning one in this country to benefit a particular industry in our midst. Indeed, Mr. Lloyd George's unnecessarily sarcastic remarks on Mr. Snowden's *volte face* suggest that even at the present day Free Traders are averse from any such expedient. But bounties, subsidies, and preferential duties are only a means to an end, and while any one of them may be open to criticism on one score or other, the desirable end is the main thing. And it is desirable that agriculture in Great Britain should have an extended and unfettered trial of the possibilities in its midst of sugar beet growing and beet sugar manufacture. So we are glad that the Labour Government has come round to the same view and is taking what are admitted to be effective steps to establish the industry.

There is no doubt that with the large population existing in the United Kingdom it is a dangerous policy to allow practically the whole of a staple food to be produced abroad and imported into this country in ships. This was one of the sternest lessons of the late war, and since there is no guarantee that the Great War was our last one (though we may well pray that it may prove so) no Government that desires to command the respect of the electorate can afford to ignore the lesson. And even if military and naval warfare be replaced by a

World Arbitration Court, it would not control commercial warfare; human nature being what it is, those who succeed in controlling the supplies of a commodity will continue to charge as much for it as they think the purchaser will stand. The best remedy against this is a plenitude of sources of supply. And as regards sugar, this country has the past decade tended to exchange a sugar monopoly governed by the beet sugar barons of Germany and Austria-Hungary for one ruled by the millionaires of the Cuban-American cane sugar industry. The former, as our past pages have shown in ample detail, was the bane of our sugar market, one year perchance discouraging production and sending up prices, another year increasing production and depressing prices to a figure at which cane sugar could not compete with profit. The consumer was told by free trade purists that he gained by it; but the real facts were that the average price he paid for his sugar spread out over several decades was higher than he would have done if sugar prices had been governed by the ordinary law of natural supply and demand. We do not want our sugar supplies again on this switchback principle, and the best means of averting it is to grow more cane sugar in our various Dominions and Colonies and produce an appreciable fraction of our consuming wants by means of our own agriculture. Then we shall be less subject to the vicissitudes of Cuban and Javan production, on which at present we depend to too great an extent.

There is of course no question of home beet sugar superseding overseas cane as the main source of our sugar supplies, any more than American beet has succeeded in replacing cane in the five million ton consumption of the States. But the American beet industry, which produces in favourable years nearly one-fifth of that total, has a steadying influence on American markets; and a healthy beet sugar industry in Great Britain might do much to steady the market here too. It is not possible to prophesy with any certainty how much sugar we shall eventually ourselves produce in this country, but certain economic conditions will militate against more than a certain proportion of the land being rotated with beets. Five hundred thousand tons may or may not prove an outside figure under the most favourable auspices of Government and capitalistic aid; but supposing it was attained in twenty years from now, it would only account for roughly 25 per cent. of our probable consumption. The rest would be either Continental beet or tropical cane. We are disposed to believe that long before that date twenty years hence any other Góvernment in this country than a Liberal one will have recognized the advantages of placing Empire sugar at least next to home-grown beet in the matter of fiscal preferences, in which event much if not most of our overseas supply would come from the Empire.

The Government's Proposals.

Mr. SNOWDEN outlined in the House of Commons the proposals of the Government for aiding home grown sugar, but did not give enough detail to allow the majority of his hearers immediately grasping the precise significance of the figures;[1] and as no explanation was forthcoming at a later stage of the same sitting, it must be assumed that neither Mr. SNOWDEN nor his deputy had memorized the details properly. However a study of the figures announced by him gave one a solution that was subsequently confirmed by enquiry in official quarters.

The Government having already in the last Budget reduced the foreign import duty to 11s. 8d. per cwt. (in terms of refined), the absence of a corresponding Excise duty on home grown beet allowed the latter this same sum per cwt.

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[1] His speech is given in full on page 407.

as their preference over foreign sugar. This compared with 25s. 8d. allowed them down to the last Budget resolutions, and was on all hands claimed by the beet sugar interests to be totally inadequate to allow the factories to make a profit after paying the farmers remunerative terms. So the Goverment has been forced to offer a direct subsidy to the industry, which it has fixed at 19s. 6d. per cwt. Simultaneously, it proposes to put on an Excise duty of 9s. 9d. which is the same sum as Empire sugar pays on entry under the preferential tariff. Under this arrangement, home grown beet will have an advantage over foreign sugar of 1s. 11d. per cwt. and be on a par with Empire sugar; that is its advantage under the operations of Customs and Excise duties. But, in addition, it is to get a subsidy of 19s. 6d. per cwt. which means that its total advantage over foreign sugar will be 21s. 5d. and over Empire sugar 19s. 6d. per cwt. Since earlier in the year the leaders of the home beet movement were stipulating that a preference of round 20s. per cwt. was necessary if the industry was to continue to expand, it will be seen that the Government have practically accepted their view.

The re-imposition of an Excise duty and the resort to a subsidy has the advantage that the benefit to the home beet interests will be unaffected by any change in the sugar duties such as a later Budget might propose. Home beet is thus to be sheltered from these changes of duties—a benefit that Mr. SNOWDEN has denied to the producers of Imperial sugar. What is more, while he refused to recognize any right on the part of previous Governments to stabilize the Imperial preference on sugar for a term of ten years and said they had no authority to pledge other Governments, he now himself pledges future Governments to continue the present form of subsidy for a period of ten years; and, what is more, he lays down the proposal that the subsidy should be 19s. 6d. for four years, then for three years 13s. per cwt., and for a further three years 6s. 6d. per cwt. Politically speaking, he no doubt feels himself on safer ground than his predecessor in making such a pledge, because he knows the Conservative party will honour it in the spirit even if not in its exact details, while as for the Liberal party, his plan is a cynical avowal that they do not count these days and are not likely to have it in their power during the next ten years to vote down the scheme. If only Mr. SNOWDEN and his Government would make as close a study of the advantages to this country of preference for Imperial cane sugar as they have seemingly done with regard to home grown beet, our sugar supply would enter upon a new era. But we suppose the distinction lies in the fact that home agriculture has votes to be won, whereas the overseas cane planter has none.

The College of Tropical Agriculture, Trinidad.

The Second Annual Report of the Governing Body of Trinidad Agricultural College has lately been issued. As we have already had occasion to point out, it was decided not long since in order that the Imperial nature of the undertaking might be emphasized to change the name of the College from "The West Indian College of Tropical Agriculture" to "The Imperial College of Tropical Agriculture." The College entered upon the second year of its existence with 11 Diploma students and two Post-graduates on the register. Before the close of the year these numbers had been increased to 17 and 7 respectively. Mr. R. G. FARNELL, Chemist of the British Empire Sugar Research Association, and Mr. R. SNOW, a Post-graduate from Oxford University, were also permitted to carry out special investigations at the College, and this privilege was, it is understood, much appreciated.

Dr. S. C. **Harland**, F.L.S., F.E.S., was appointed Professor of Botany in succession to Mr. T. G. **Mason**, M.A., B.Sc., Agr.A., who vacated that post upon his appointment to be Senior Botanist in the Agricultural Department of Nigeria. Mr. W. R. **Dunlop** was appointed Professor of Economics. In order that research might be carried on without interruption and that Officers might be available to carry on the work of the Imperial Department of Agriculture and visit the neighbouring islands when required, Dr. C. L. **Withycombe**, M.Sc., D.I.C., F.E.S., Mr. E. E. **Cheesman**, B.Sc., A.R.C.S., and Mr. P. E. **Turner**, B.Sc., A.I.C., were appointed Assistants to the Professors of Zoology and Entomology, Botany, and Chemistry respectively, with the titles of Lecturers. And since the Report was issued we learn that Sir **Francis Watts**, K.C.M.G., who is retiring from the post of first Principal of the College, has been offered the honorary position of Principal Emeritus.

In accordance with the recommendations of the Executive Committee, the following Free Scholarships have been placed at the disposal of the contributing Colonies:—Trinidad 12, Barbados 6, the Windward Islands 4, and the Leeward Islands 4. The Governors have had under consideration the question of granting Degrees in Agriculture, but felt that this would be premature and that meanwhile the College Diploma of Agriculture would meet the case.

The contract for erecting the new Buildings and Research Laboratories has been awarded to Messrs. **Foster & Dicksee** of Rugby, England, and the latter started operations in July 1923, while the foundation stone was laid last December.

On another page we give full details of the course of study being followed at this college, and facing page 409 will be found an illustration of the College buildings, as they are expected to appear when completed.

The Future of the Philippines.

The United States Congress has recently had before it two bills, both of which have as their object the granting immediately of complete local autonomy to the people of the Philippine Islands, and of independent sovereignty at the end of a fixed period—20 or 25 years.[1]

Opinion in Government circles in the States has just recently moved rapidly in increased favour of granting the Filipino demands for independence. Political critics aver that there is some connexion between the recent Japanese Exclusion Bill and the decision to abandon the Philippines. If that were so, then reading between the lines one could only assume it to imply that if Japan chooses to step into America's suzerainty shoes in those islands at some future date, America is no longer concerned. It is more likely, however, that the president and his advisers have become convinced that Filipino public opinion is practically unanimous; that political restlessness and economic disturbance will remain chronic unless a gateway is opened to Filipino ambitions; that the American people are weary of, and have ceased to take an interest in, the islands and their destiny; and that an unfortified Philippines is of no strategic value to the United States, while there is the possible consideration of the British Government having abandoned its plan to fortify Singapore.

Anyhow, there is supposed now to be a good chance of Congress passing the measure to effect this Filipino independence. As for the foreign community in the Philippines, of which the British are commercially predominant, the prospects are regarded with misgiving. It is realized that as soon as the United States withdraws from the islands, the new Filipino Government, threatened with insolvency, will be compelled to discover new sources of revenue; and as their people will not tolerate increased taxation, it is a foregone conclusion that the foreigners will be the victims.

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[1] For the information given in this note we are indebted to a long article in the *Times* from its Manila correspondent.

How the islands will get on under autonomy remains to be seen. It is pointed out that as between the Christian Filipino and the Mohamedan Moro who comprise the indigenous population, there is no nearer kinship than there is between the Japanese and the Koreans, or between the Moslems and the Brahmins in India. "The Christian Filipino wastes no more love on the Moro than he does upon a king cobra, and it may be said that the Moro delights to bare defiant fangs to the Filipino. . . . . Among the Mahomedan Malays of Mindanao and Sulu, as elsewhere, lying and deceit are not a vice but a fine art. The Moros are inherently lawless. By instinct and tradition they are 'agin the Government,' and no one who has taken the pains to study the characteristics of these strange people believes for a moment that they will ever lie down at the bidding of Filipino rulers. It is safe to say that when, if ever, the Filipinos assume entire control of the islands, there will be trouble brewing among the Moros."[1]

The Half-Year's Consumption in the United States.

According to Willett & Gray's calculations, the indicated consumption of sugar in the United States during the first half of 1924 amounted to 2,684,972 long tons, as compared with 2,593,691 tons for the corresponding months of 1923, and 2,671,953 tons for 1922. Thus, although business conditions generally throughout the country have not been the best during the past two or three months, and also while general conditions in the sugar business almost entirely throughout the six months have left much to be desired, yet the consumption for this half-year has proved the largest on record. It represents an increase over 1923 of 91,281 tons or 3·52 per cent., while Messrs. Willett & Gray consider it a remarkable fact that it also exceeds the figures for the first half of 1922, which year was the record year of consumption, taking the whole 12 months into calculation. In 1922 the 12 months' consumption amounted to 5,092,758 tons; this year, if we are right in assuming that the second six months with its large demands for sugar for canning and preserving will at least equal the first six months, the total consumption may amount to about 5,370,000 tons, a figure which would easily prove a fresh record. If substantiated, it would imply a consumption as compared with 1923 of an extra 600,000 tons of sugar, and should go some way to preventing increased production from outrunning the world's consumption, with the consequent drop in prices.

In general, states our contemporary, this increase in the American consumption can be attributed largely to the steadily augmenting population in the States and to the fact that even if business conditions have not been the best, there has, nevertheless, been very little unemployment, and the entire population has been able to obtain all the sugar required.

Wolzogen Kuhr found that *Bacterium herbicola* is present in most canes affected by the sereh disease, and he drew the conclusion that this organism is in all probability the cause of the disease mentioned. G. Bremer in a recently communicated bacteriological study[2] shows there are several strains of the organism, these differing in their heat-resisting capacity, the thermal death point of some being as high as 56°C. In treating cane seed with hot water previous to planting it out, a temperature of about 50°C is considered sufficient to render the stalks sterile, so far as *B. herbicola* is concerned.

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[1] The *Times* correspondent referred to

[2] *Archief*, 1924, 32, No. 3, 55–64.

Fifty Years Ago.

From the "Sugar Cane," August, 1874.

In this issue **Prosper Lagrange** continued from the previous one his contribution on the purification of syrups by means of baryta and phosphate of ammonia (as already noted[1]); and here dealt with the manufacture of these two chemicals by methods employed at that time in factories in France. Then following this there was an article by **Fernique** criticizing the Lagrange process.

He remarked in the first place that it appeared uncertain that "all the organic compounds are precipitated by the baryta." He further said "it is a certain fact that every time we add a soluble phosphate to a syrup containing lime, or salts of lime, we set on foot a double decomposition. The lime is precipitated in the state of phosphate of lime, and the vegetable or mineral acid, combined with that lime, will form with the base of the phosphate another soluble salt." When the acid combined with the lime is sulphuric acid, the baryta having affinity for it will eliminate it, but when the acid is of organic origin the organic acid combines with ammonia, which ammonia-organic-acid salt would probably be at least as objectionable from the melassigenic point of view as the lime salt previously existing. Then the alkalis (potash and soda) previously combined with the organic acids would be liberated, and in turn ammonia would be disengaged. But one of his principal objections was the possibility that some baryta might pass into solution as the organic acid salt, a "hypothesis which would have this double danger of retaining a salt perhaps more injurious than the first, and of leaving baryta in the syrup in solution." Furthermore, any baryta, either in solution or as barium phosphate, escaping from holes in the filter-bags, might be taken up by the char, and later given up to the next syrups passing through it.

Lagrange then replied to these criticisms. In regard to the first objection, he said that he had never claimed that all the organic impurities in the raw syrup could be precipitated by the baryta, having only stated that "the new process of chemical purification . . . . rests on the elimination of certain mineral and organic compounds which are very injurious to the crystallization of sugar under the double action of baryta and phosphate of ammonia." As regards the substitution of potash and soda for a calcium salt, this was an entirely beneficial effect. One has only to observe the difference in the viscosity of a strike after the lime salts in it had been decomposed by the addition of baryta or other precipitant to recognize its value to the sugar-boiler, a very bad cuite giving an insufficient crystallization being transferred into a good one having a high return. Lastly, the suggestion that baryta might pass into solution in the syrups as soluble or organic acid salts was repudiated, it being pointed out that this could not occur in the presence of sulphates, and that according to the prescribed method only a faint excess above that required to precipitate these was added. That baryta would be imparted to the syrups passing through the char cisterns was impossible, because any baryta that might be taken up by the char would during revivification be transformed immediately to barium carbonate. His process had been in operation in factories and refineries in France, **Lagrange** finally stated, and "it does not appear that sugars extracted by the aid of baryta have ever done the least harm to consumers."

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[1] *I.S.J.*, 1924, 294, 352.

The Government's Intentions towards the Beet Sugar Industry.

Statement in Parliament.

On July 30th in the House of Commons the Government through the Chancellor of the Exchequer made its long awaited statement of the aid it proposed to give to the home beet sugar industry. The following was Mr. Snowden's speech as taken from the official Report:—

Mr. Snowden: I want to say a word or two upon a matter on which I have promised information to the House on more than one occasion. That is the question of sugar beet. The Government have accepted the principle of Exchequer assistance for the sugar beet industry. The beet sugar factories which are in existence in this country have already received assistance from previous Governments. They have also had the advantage of freedom from Excise Duty, equivalent to the Customs Duty on imported sugar. I reduced the Sugar Duty very considerably in the last Budget. Then representations were made to us that it was impossible for the British beet sugar factories to carry on in their initial stages unless some further assistance were given. The effect of the present arrangement, freedom from Excise Duty, is that they get an advantage of 11s. 8d. a cwt. Before I made a reduction in the Sugar Duty the advantage was 25s. 8d. a cwt., or some such figure. They could just struggle along with that advantage, but they cannot do so with the advantage of 11s. 8d. a cwt. The other members of the Government and I have given the matter very full consideration.

We propose that there shall be an Excise duty, equivalent to the existing preferential Customs duty, put upon sugar manufactured in this country. Of course, the sugar will get the advantage of that preference. Therefore an Excise duty of 9s. 9d. would be put upon beet sugar manufactured in this country and we propose that they shall get a subsidy of 19s. 6d per cwt. The advantage of that, from the Exchequer point of view, is that it leaves the Chancellor of the Exchequer entirely free in the future to deal with the Sugar Duty. He may reduce it, or abolish it altogether, but there would not arise this question which has arisen as a result of the recent reduction in the Sugar Duty.

A very crucial matter in this connexion is being able to get a sufficient supply of beet at prices which will encourage the farmer to produce, and we have come to the conclusion that it will be necessary to fix the subsidy at such a figure as will enable the manufacturer to give a price for the beet which will be an encouragement to the farmer. We have considered the question of a possible subsidy to the farmer, but after looking at the question from every point of view we came to the conclusion that there was grave objection to that course Representatives of the National Farmers' Union and others who take a good deal of interest in this question in various parts of the country were of opinion that a price of 54s. per ton would be necessary to attract new growers to a district, but we have come to the conclusion, after weighing all the evidence, that such a high figure as that is not necessary and that the subsidy which we propose to give will enable the price of 44s. per ton to be given to the beet grower.

There is not, as far as we can discover, any case in the world where a beet sugar industry has been developed except with the assistance of the State. Holland has an exceedingly flourishing beet sugar industry which supplies the whole of Holland's needs and leaves a considerable surplus for export, and that industry received assistance in its early years, though for a long time back it has been entirely self-supporting. Therefore, after full consideration, we have come to the conclusion that a period of 10 years is necessary during which State assistance is required to enable the industry to get upon its feet and develop sufficiently to stand alone. There are many reasons why that is necessary. We all know what a conservative lot the farmers are, and it will require a long time to induce them to adopt new methods. We, believe, however, a period of 10 years will be sufficient for that purpose, and the subsidy might be upon a diminishing scale during that period. That would have the further advantage of supplying an incentive for the erection of factories in the earlier years when the subsidy is higher.

SIR LEONARD LYLE : May I ask the right hon. Gentleman whether that subsidy is to be given on the refined sugar or merely on the raw sugar?

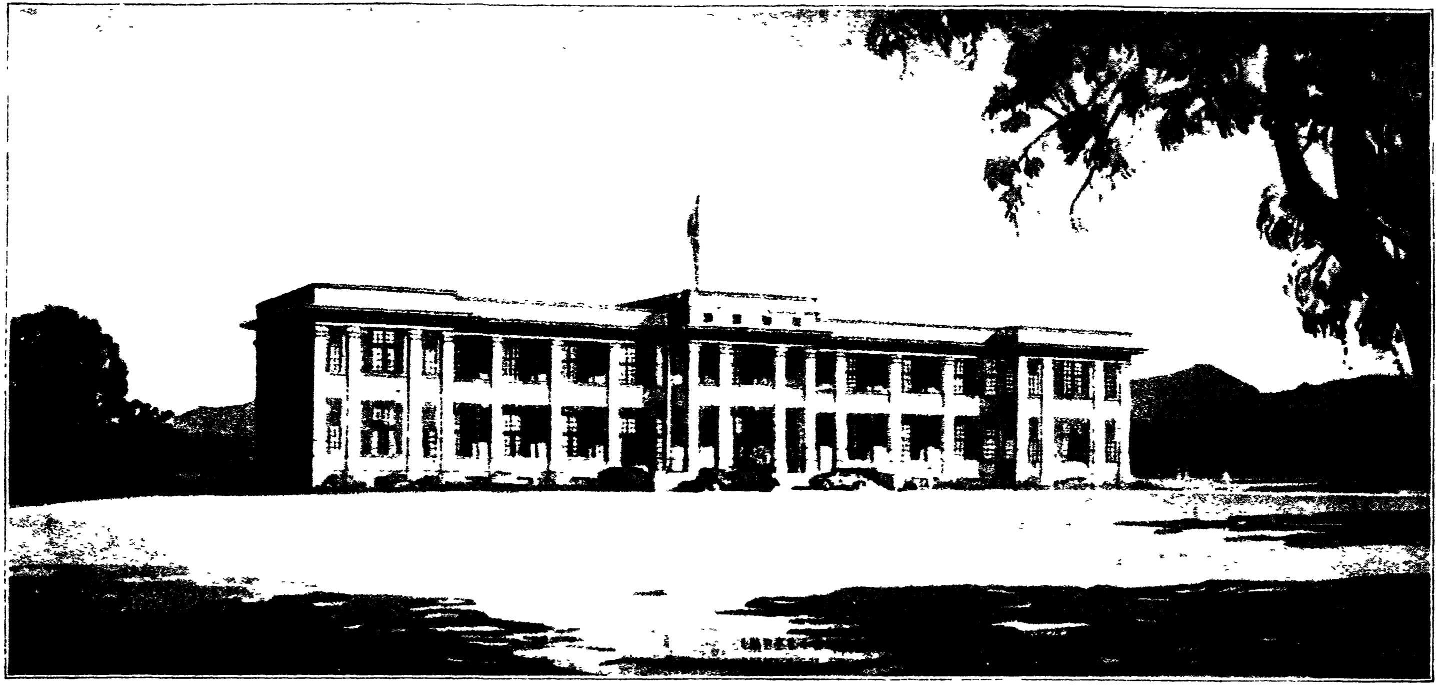
MR. SNOWDEN : I think it is going to be given on all sugar which is produced in this country. We suggest the rate of 19s. 6d. should be subject to a falling scale. It might be reduced to 13s. in four years and again reduced to 6s. 6d. after a further three years, and at the end of 10 years it might be removed altogether, and, as I said before, Excise duty at the appropriate rate would be charged from the outset, so that the net cost to the Government would only be 9s. 9d. per cwt. when the subsidy is being paid at the full rate. Legislation will of course be necessary to carry out this proposal. I may say a word or two as to the possible effects of the proposal. We are assured that if this subsidy were granted, about half-a-dozen new factories would be started almost at once, which means the employment of a great deal of labour in the production of the machinery. I am told a new factory costs about £200,000, representing the employment of a great deal of labour, and this expenditure would be incurred in this country. A good deal of labour would also be employed in growing the beet and bringing it to the factories. I understand that a sugar factory at present employs between 500 and 600 men in the winter and a smaller number in the summer.

May I take the Committee so far into my confidence as to say that I approached the consideration of this question, I will not say with hostility, but certainly not in a favourable or sympathetic frame of mind. I have given very long consideration to it, and the more I see of its possibilities the more enthusiastic I become. I believe it is one of the very biggest things that can be done for British agriculture. I believe it will revive British agriculture and restore rural England, and I am confident, so successful will the early stages and the early experiments be, that the areas devoted to sugar-producing purposes will extend until this country is in a position to produce a great part of the sugar which it requires. I think it is necessary, if the scheme we are going to propose is to be carried through, that it should be carried through, I will not say with the unanimous approval of the House of Commons, but at least with a certain measure of agreement among all parties. Whether we shall be able to secure that agreement or not I do not know, but I believe very strongly in its possibility, and I should very much regret if this proposal were not carried into effect.

Mr. LLOYD GEORGE who claimed to have been the first, as a Liberal Chancellor of the Exchequer, to give differential treatment to beet sugar, said he was not very clear what Mr. Snowden's proposals amounted to as to the net preference for home grown beet, and asked how the figures worked out. This apart, he was rather sarcastic of the Chancellor's conversion from a spirit not merely of indifference but of active hostility, to one of exaltation which had led him to see a vision of the whole agriculture of this country regenerated, reconstructed, renewed, resurrected, and the rural population arrested. He wanted to know how it was to be done, considering that when the existing factories were getting 24s. per cwt. preference, they only each employed 600 men in winter and 200 in summer.

Sir LEONARD LYLE remarked that it was most interesting to find that the Chancellor of the Exchequer, who was looked upon as the most stalwart apostle of pure Free Trade, had turned into a full-blooded protectionist. But he complained that in giving a bounty and a present to one industry, the Government was not fair and just in avoiding damage to anyone else. He objected as a sugar refiner to the preference being given on the finished sugar instead of on raw sugar only, and said the home beet industry should be protected against the foreigner but not against the home refiner. The Government should subsidize the industry in such a way that it did not help to smash old established industries like that of the sugar refiners.

Sir L. WORTHINGTON EVANS, speaking on behalf of the Conservatives, also professed to be somewhat mystified as to the exact incidence of the preference granted; but he welcomed the proposal to support the sugar industry. He thought they would have to consider the exact terms of the sliding scale and the exact terms on which the subsidy was to be given, but he was delighted that the Chancellor had learnt some wisdom from the Budget debates.



The New Building of The Imperial College of Tropical Agriculture, after the design by Major Hubert C. Corlette, O.B.E., F.S.A., F.R.I.B.A.

The Imperial College of Tropical Agriculture.

The Prospectus for 1924-25.

The Imperial College of Tropical Agriculture, Trinidad, which was formally opened in October, 1922, is at present housed in provisional buildings at St. Augustine, seven miles to the east of Port-of-Spain. An illustration of the permanent building which is in course of erection is given adjoining.

The prospectus for the 1924-25 year (October 1st to June 30th) has just been issued by the authorities and the following particulars as to the curriculum are taken from its pages.

Admission of students.—Applications for admission should be addressed to the Registrar, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, or to Mr. ALGERNON ASPINALL, C.M.G., Secretary, 14, Trinity Square, London, E.C.3, from whom all particulars may be obtained.

Students must have attained the age of 17 years before the date of their admission to the College, and those entering for the Diploma Course are required to pass the Entrance Examination of the College, which will be held at convenient centres in the United Kingdom and the Colonies in June. Candidates for admission will be required to pass in English, Mathematics, History and Geography, and one language. An optional paper in general Elementary Science will be provided.

Exemption from this examination will be granted to applicants presenting evidence of having passed an examination of equivalent educational standing, e.g., the Matriculation Examination of any British University, or the Higher School Certificate granted by the Cambridge Local Examinations Syndicate, the Higher Certificate granted by the Oxford and Cambridge Schools Examination Board, or the Higher School Certificate granted by the Oxford Local Examinations Delegacy; provided that the candidate has passed in all subjects required for the Entrance Examination as set out in the preceding paragraph.

Post graduate students.—Special facilities are available for graduates of other Colleges, Universities, or University Colleges desirous of extending their knowledge of subjects pertaining to tropical agriculture, or of undertaking investigations into these or related subjects in tropical surroundings.

Fees.—The fee for tuition in the Diploma Course is £50 per annum. A limited number of students from Colonies and industries contributing towards the maintenance of the College will be admitted on the nomination of the respective local Governments or industries without the payment of tuition fees. Other students from contributing Colonies will be admitted on payment of tuition fees of £25 per annum. Minor laboratory charges, text books, etc., will be extra. The subscription to the Students' Union (to include the College Clubs) is 30s. a year payable with tuition fee to the Registrar, 17s. 6d. on October 1st, and 12s. 6d. on January 1st.

Residence.—The College is at present non-residential, but a register of approved lodgings is kept and students can obtain information and assistance in regard to finding suitable accommodation from the Registrar.

THE DIPLOMA COURSE.

The College offers a three years' course of study leading to a Diploma in Tropical Agriculture. To obtain the diploma, students shall pass three examinations which will normally be taken one at the end of each academic year.

I. *The first examination.*—This shall be taken by *all* candidates, and shall include the following subjects: (1) Agriculture, (2) Botany and Zoology, (3) Chemistry and Physics, (4) Mathematics, (5) Economic History and Geography.

II. *The second examination.*—At the commencement of the second academic year, students will state which one of the three courses (*a*), (*b*), (*c*), they elect to take.

(*a*) *Estate management.*—This course is intended for students who wish to become tropical planters or agricultural administrators. The examination shall include the following subjects: (1) Agriculture (Agronomy and Forestry), (2) Agricultural Botany and Zoology, (3) Agricultural Chemistry, (4) Agricultural Engineering, (5) Veterinary Science, (6) Economics (Statistics and Accountancy).

(*b*) *Agricultural sciences.*—This course is intended for students who wish to become specialists in some branch of agricultural science, experiment station officers, teachers or extension workers in agriculture.

The examination shall include the following subjects: Agriculture (Agronomy and Forestry), (2) Agricultural Botany and Zoology, (3) Agricultural Chemistry, (4) Agricultural Engineering, (5) Special Biology.

(*c*) *Chemical technology.*—This course is intended for students who wish to become specialists in the manufacture of tropical plant products. At present, facilities mainly for the study of sugar technology are provided; it is hoped later to extend these to include the technology of other plant products.

The examination shall include the following subjects: (1) Agriculture (Agronomy), (2) Agricultural Chemistry, (3) Agricultural Engineering, (4) Economics (Statistics and Accountancy), (5) Chemical Machinery, (6) Elementary Colloid Science, (7) Agricultural Botany (Microbiology).

III. *The third examination.*—The third examination will comprise the following subjects:—

(*a*) *Estate management.*—The examination shall include the following subjects: (1) Agriculture (Agronomy, Animal Husbandry and Estate Organization), (2) Economics (Agricultural Law, Economic Theory and Marketing), (3) Manufacture of Crop Products.

(*b*) *Agricultural sciences.*—The examination shall include the following subjects: (1) Agriculture (Agronomy), (2) Ecology of Crop Plants, (3) Genetics, (4) Mycology and/or Entomology.

(*c*) *Chemical technology.*—The examination shall include the following subjects: (1) Manufacture of Crop Products, (2) Special Chemical Technology, (3) Factory Control, (4) Analytical Chemistry, (5) Economics (Economic Theory and Marketing), (6) Mycology (Microbiology).

Fourth year courses.—The College offers fourth year courses for students who wish to specialize further in some branch of agricultural science or in chemical technology, in particular, sugar technology. The courses will be specially arranged to meet the requirements of these students.

One year course.—This course is offered to meet the demands of students who cannot afford the time involved in a three years' course of study. The subjects will be chosen from those included in the diploma course.

Post graduate courses.—Post graduate courses will be arranged to suit the particular requirements of advanced students. The subjects will be selected mainly from the third year diploma course, and from fourth year courses.

College associateship.—The Associateship of the Imperial College of Tropical Agriculture may be awarded to holders of the College Diploma on the presentation of a thesis and its acceptance by the Academic Board. Not less than one year must elapse between the passing of the diploma examinations and the presentation of a thesis. The Associateship may be awarded to graduates of any British

University or University College or other Academic Institution specifically approved for that purpose by the Governing Body of the Imperial College of Tropical Agriculture after completion by the graduates of a course of study at the College of not less than one academic year and the presentation of a thesis and its acceptance by the Academic Board.

Dates of examinations.—Examinations will normally be held at the end of the academic year but supplementary examinations for those candidates who fail to satisfy the examiners in the annual examinations will be held at some time before the end of the first term of the academic year. Notice of the exact dates of the supplementary examinations will be posted on the College notice board.

Field work.—The College is situated within easy access by rail or road to estates and plantations where sugar cane, cacao, coffee, coconut, banana, Indian corn, rice, rubber, citrus and numerous minor crops are grown. The Government Experiment Station and Stock Farm, controlled by the Trinidad Department of Agriculture, lie in the immediate vicinity of the college grounds. Unreclaimed forest land and savannah, forest preserves and agricultural holdings in all stages of development occur within the island. Students are enabled by frequent excursions to visit these regions, and thus to obtain first-hand knowledge of the principles of tropical agricultural practice, the methods of biological experimentation including plant breeding, and the nature and control of plant diseases and pests. In addition, students of chemical technology are given opportunities of inspecting sugar factories, cacao and coffee curing plants, copra dryers, a citrus products factory and a plantation rubber factory.

Sugar technology.—It may be added that the Syllabus of Study of Sugar Technology will comprise the following: The Units of the Sugar Factory and their Co-ordination. Juice Extraction. Clarification. Filtration. Evaporation in Multiple Effects. Sugar Boiling in the Vacuum Pan. Crystallization and Separation of Crystals in the Centrifugal. Grading and handling of Sugar and Molasses. Theory of Molasses Formation. Bagasse as Fuel. Sugar Factory By-products. Sugar Factory Management.

The Instructional Sugar Factory.—The Annual Report of the Governing Body recently issued shows that the erection of the instructional sugar factory, designed by Mr. CLAUDE T. BERTHON, A.M. Inst. C.E., is to be proceeded with without delay. Several additional offers of plant and machinery for the factory have been received. The full list of contributors is as follows :—

Allen Everitt & Sons, Ltd.; David Auld & Sons, Ltd.; W. & T. Avery, Ltd.; Babcock & Wilcox, Ltd.; Sir W. H. Bailey & Co., Ltd.; Bakers (Leeds), Ltd.; Belliss & Morcom, Ltd.; Fredk. Braby & Co., Ltd.; The British Thomson-Houston Co., Ltd.; The Broughton Copper Co., Ltd.; Donald Clerk & Son, Ltd.; A. F. Craig & Co., Ltd.; S. Denison & Co., Ltd.; Drysdale & Co., Ltd.; Joseph Evans & Sons, Ltd.; Fawcett, Preston & Co., Ltd.; Geo. Fletcher & Co., Ltd.; Glenfield & Kennedy, Ltd.; E. Green & Son, Ltd.; The Harvey Engineering Co., Ltd.; Holden & Brooke, Ltd.; J. Hopkinson & Co., Ltd.; S. H. Johnson & Co., Ltd.; Millen Bros.; The Mirrlees Watson Co., Ltd.; Henry Pooley & Son, Ltd.; Pott, Cassels & Williamson; The Sainte Madeleine Sugar Co., Ltd.; Shaw Glasgow, Ltd.; A. & W. Smith & Co., Ltd.; Stewarts & Lloyds, Ltd.; Watson, Laidlaw & Co., Ltd.; G. & J. Weir, Ltd.; Worthington-Simpson, Ltd.

It is interesting to note that the King is taking a share in the production of beet sugar in Norfolk, inasmuch as he has contracted for three years to grow on his Sandringham estate a certain quantity of sugar beet for the Cantley factory.

Bud Selection Work in Hawaiian Sugar Plantations.

A great deal has been written at odd times about bud variation in the sugar cane, but it is hard to find any literature of scientific value on the subject. It may be assumed that, until recently, the cultivated cane has been reproduced by simply planting pieces of stem, that is without sowing any seed, and therefore asexually or by vegetable propagation. And, this being the case, it is a matter for speculation as to how the immense number of varieties grown in the fields have arisen. Among the chief advantages of this method of propagation over seed sowing among cultivated plants are the following: (1) That in large plants, and especially in perennials, the adult stage is reached much sooner, and (2) that the successive "generations" are more or less identical in character, the constant variation of seedlings being ruled out. It is specially noticeable in sugar cane that no two seedlings are alike. But all improvements in the character of crop plants ultimately depends on variation, and we are forced to assume that, in the sugar cane and other plants vegetatively reproduced for long periods, there *is* a constant tendency to vary (maybe occurring only at long intervals) by which new forms arise. One of the most valued characters of the sugar cane is the richness of its juice in sugar, but unfortunately there are no means by which this can be detected before the cane is cut and its juices analysed. On the other hand vigour in growth, thickness of stem and so on, can be readily seen in the field; but the cane plant has been found to be so variable in these respects on account of its environment, (whether the character of the soil, the climate, its treatment or what not) that the slightest change in these conditions may be assumed to have its effect on the appearance of the plant. Besides this, we must not forget that it has been demonstrated that, in the complex of branchings which make up any clump or stool, there is a regular progression in thickness, length of joint, date of maturing and other characters, from the first or mother shoot through the branches of first, second, third and higher orders if any, the latest formed being uniformly thicker and longer jointed. We are thus practically deprived of criteria of value when we try and obtain improved varieties by a careful examination of the cane stools in the field. In spite of all this, we are driven to conclude that the gradual evolution of the splendid cane varieties which were in general cultivation when the fertility of the cane flower was first discovered has been brought about by selection in the field. And there *is* one character, it is true of little economic importance, in which a change in the plant may be seen to be now taking place everywhere, and can be clearly traced to bud variation. Colour changes can be seen in almost every field of striped canes, although such changes are apparently more common in some places and varieties than in others; and it appears to be probable that this phenomenon has been known to exist as long as the cane has been cultivated and striped canes have existed. The origin of striped canes has led to much controversy, but the former idea that at some period they were produced by the union of two canes of the colours forming the stripes is not now favoured; for striped canes are now known to arise in the fields spontaneously and, not infrequently, in fields of one uniform colour, and some of these have been traced to outgrowths from single buds. When such a striped cane arises, the pieces of the branches when planted in the field produce in successive generations canes that are also striped in the same manner. But it is possible that this character of striping is not so stable as one required for economic purposes, or indeed it may be of a different character. Sometimes faint striping is to be found in many canes of one variety, unevenly distributed over the clumps, or indeed over the individual stems;

and cases are not uncommon in which the striping may suddenly cease completely half way up the stem, removing this change entirely from the category of bud variation. Further, it is a common observation that striped canes are constantly breaking down into one-coloured canes, which assume one or other of the colours which are united in the parent cane. Such cases have been frequently referred to in cane literature, and a useful example may be here mentioned, where a coloured illustration is given of the change taking place, in the *Agricultural Journal of India.*[1] Here a set taken from a red and yellow striped cane is seen to produce from its middle bud a shoot bearing six branches or tillers, one of which is red, two striped and two green. Similarly coloured canes were at the time frequently met with in the plots of striped canes, and they were grown as separate varieties and tested as to their characters for several years. The green form, termed locally "Green Sport," turned out to be the most vigorous, but was lacking in sugar content in the juice and was ultimately rejected; the red variety on the other hand tillered less but had richer juice, even better perhaps than the mother cane, which was more or less intermediate between the two in vigour and juice, but approximated rather to the red. This latter, termed "Red Sport," became in certain tracts a useful commercial cane.

Colour of cane is perhaps its most easily recognizable character, and it is not altogether unjustifiable to assume that there are as constant variations in other characters not so readily perceived. But we have no guarantee that this is so and the number of cases of known mutations is far fewer, although a search in the literature would probably be rewarded by finding details regarding some of them, as, for instance, the appearance of Caledonian Queen in the West Indies. Among the most important characters desired in sugar cane crops are richness of juice, early maturing, vigour, resistance to specific diseases, drought resistance, and total sugar obtainable; and, although the latter character is probably a very complex one, it is possible that bud variations may assist in all these directions. The subject is of sufficient importance to deserve a very much more careful study than has been accorded to it in the past, and it is very gratifying that, in the all round survey of the means of increasing their crop, the Hawaiian planters are conducting a strenuous campaign on just these lines, namely, to try and capture such bud mutations of economic value as may occur in the crops of the island. Although this campaign has apparently been started for several years, little information beyond the bare fact has come our way; but recently three papers[2] have reached us, a study of which will give some idea of what is being done, and what is thought in the island of the prospects of success in this important line of work.

In the first of these papers, Shamel, the originator of the campaign, deals briefly with the results obtained in 1923 in harvesting the plots sown in 1922, this being the chief work of the year; and a detailed report is promised as soon as all the results have come in. The author is encouraged by the year's work and writes: "In most fields certain progenies have stood out as unmistakeably better than the others and as evidently inherently superior. This superiority has been shown by the large number and size of stalks in the stools, which were uniformly above the average and by the fact that the stools in these progenies were all uniformly good. This condition indicates inherent stability for these characteristics which are correlated with high yields." These results are assumed to be due to the frequent presence of bud mutations in the fields and their comparatively easy recognition when the fields are submitted to a systematic and careful scrutiny.

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[1] The origin of new sugar canes by bud-variation. C. A. Barber, *Agricultural Journal of India*, Vol. I, October, 1906.

[2] The progress of bud selection work (from a report by A. D. Shamel) Report of the Committee in charge of the Experiment Station, Hawaiian Sugar Planters' Association, for the year ending September 30th, 1923.

A comparison of bud selected strains (from a report by J. A. Verret). *Ibid.*

Report of the improvement of cane by selection. F. A. Paris. Presented at the second annual meeting of the Association of Hawaiian Technologists, Honolulu, October 22nd, 1923.

The method adopted appears to be simple and may be briefly summarized as follows: Officers well acquainted with the varying characters of cultivated canes pass through the fields, and using certain criteria, select and mark outstanding clumps or stools. Careful notes are taken of the exact location of each selection (details being entered on a map of the field), and of the characters, surroundings and treatment of the clumps during growth. When matured these clumps are harvested separately, the number and weight of canes in each are determined, and they are used for separate planting in what are called "progeny rows." Tops are in general the only part used for seed, these having been found to be superior to pieces of the whole cane in Hawaii under normal conditions; and each top is very carefully examined, especially as regards the possession of thoroughly healthy buds, and if in any way deficient it is thrown away. The tops of the selected stools are planted in continuous rows and, after growing for a year (?), are harvested for planting purposes unless the canes are considered immature. Each progeny row is also submitted to a careful examination; the number of canes in the clumps and the weights of the individual stools are taken, and the total length of the row measured by a steep tape. From these data it is easy to calculate the number of canes per foot in each of the progenies; and only those are proceeded with which show a distinct superiority over the average for the section of the field in which they are grown, all others being used for field planting if the buds are seen to be healthy.

The seed for the next year is obtained in a similar manner, only that the progeny row stands in the place of the general field. Before harvesting, each row is examined for outstanding stools and these are marked and furnish a fresh series of progeny rows, the rest being as before returned to the field for general sowing. The main criteria appear in all cases to be the number and weight of the canes harvested. If in any progeny row adjacent clumps are seen to be worth going on with, the canes cut are placed at the foot lying in opposite directions, "butt to top and top to butt," to prevent the possibility of confusion. Uniformity is aimed at in this selection, those clumps being preferred in which the canes are uniformly large over such as vary from large to small. The process is repeated year by year until a similar uniformity is obtained in the whole row, there being then presumably no further selection possible along these lines.

A study of the year's work has revealed certain defects in the system. It was found that the 1922 clumps were often not grown from single buds, entailing the need for careful separation in cutting, and presumably confusing the issues because of the space available for the canes from each bud. In a few fields, owing to great and continuous growth, the canes were not considered mature in the sense of supplying good planting material. The rows were planted "snake fashion" that is to say in a continuous series, so that some occupied part of a row, others a whole row and some more than one row; this obviously led to the inclusion of a varying number of end clumps which again would affect the results. It is proposed to stick to one row for each progeny so as to equalize the number of end plants. In some cases only were maps prepared, and as these were found extremely valuable, their universal use is recommended as stakes may be lost or may be difficult to find in the ratoon crop. It was further found that trashing and topping the clumps immediately before harvesting greatly facilitates the observation. It is obvious from these remarks that the system is still in its infancy, and that for some time improvements will suggest themselves each year.

Besides this study of the 1922 plantings, further selection of stools in the fields were made, "it being unlikely that all the mutations would be discovered in a hurried selection," such as appears to have been made in that year. A great attempt was made to interest all connected with the industry in "spotting" likely stools, and even school children were induced to help in this important work. Attempts were made to isolate disease-resistant varieties in Lahaina fields, and these the author states have met with very encouraging results. Such attempts are of course not new, as we believe that they have been repeatedly made, for instance for specific diseases in Java and India, but generally without success. The work is however justified, for undoubtedly such new forms have arisen in the past, as an instance of which might be mentioned again the Caledonian Queen in the West Indies. SHAMEL mentions that in this study a considerable number of interesting mutations have been noted in the fields, usually in one or two canes of a stool, but he does not give any clue as to the character of such variations; these are being grown on to test whether they are inherent. He noted that "several plantation managers have stated that in their opinion the improved condition of their crops was largely, if not wholly, due to their use of superior planting material secured from their best fields . . . . in some cases inspectors accompanying each cutting crew to see that seed pieces were only cut from healthy and desirable stalks." The author, lastly, looks forward to "the systematic production of adequate supplies of progeny-improved plant material for use on all of the plantation fields within the next two or three years."

In the second paper, VERRET reports that bud selection was continued on a large scale during the year, nearly all plantations having some areas devoted to the work. But, although he believes that definite progress has been made, he considers that it is too early for definite conclusions to be drawn. A small test at Makiki appeared to him to be very promising. At the second selection five progenies were planted chequer-board fashion, with five repetitions of each. These were harvested when about one year old, and progeny No. 1 was better than any other next to it, while No. 2 was (with two exceptions) worse than any neighbour. In his old notes he found that No. 1 was marked as a "good type" while No. 2 had "a bad type" opposite to it. In emphasizing the difficulty of the work he suggests that there may be only one or two mutations present, and that it may take one or two years before the false ones will be separated from the true. H 109 is a new cane and may have very few mutations; striped sports of it do occur but not very commonly and, by analogy, this may be true of other variations. Owing to the difficulty of recognizing the type wanted, selections are at present based on weight of cane per foot of row, only selecting those above a certain standard based on the average. But in the plantations a much more careful selection of seed is being made; this he considers a great advance and worth all the trouble taken in carrying out the bud selection campaign.

In the last paper, PARIS is frankly critical of the work as at present being carried out, and states that it is decidedly too early to report. The environment causes such enormous fluctuations, that "only after many years of accurate testing of individuals and progenies will any light be thrown on the problem of bud selection." Besides this, there are certain defects in the present methods, which may lead to wrong conclusions. It is only after a certain period of individual study that one can get correct ideas as to the characteristics of the different types. At present the work is going on too fast, and two separate things are being aimed at, *mass selection* for plantation seed and *bud selection* for obtaining new and improved types. He proposes to separate the two, to keep back the present system for a while and himself concentrate on the study of the pure strains. Two schemes are however drawn up for general information as to the method to be adopted in mass and bud selection.

(1) *Plantation or mass selection.*—This commences with a special picking out of the best stools for seed, and planting them in a nursery: in the following year the seed obtained from the nursery will be put into the propagating field: and a year later released for general field cultivation. An endless chain of good seed will thus be laid down, in that every year a fresh selection for a nursery will be made and a distribution of improved seed for the plantation is provided for, so that as one series is completed a new one is started. The areas involved are laid down by the author, for an estate planting 500 acres a year, as 20 for the nursery and 100 for the propagating field, the proportions being 1 : 5 : 25; this means that, for every acre planted, a quarter of an acre will be required for raising seed alone. He remarks that, for seed, tops obtained preferably from matured ratoons are the best, but that in adverse conditions hard seed (presumably whole canes cut up) will give better results. The better the seed the greater care will be required to make it germinate promptly. The choice of ratoons for seed will give more time for the plant to become adapted to its surroundings, and thus natural selection is called in to assist in the choice of good seed.

(2) *Bud selection.*—In the first place it is of course of prime importance that the unit must be an individual bud: while in later stages mass selection may be called in to keep pure any strain evolved. The first stool should be submitted to a very careful study, photographed, and notes recorded. It is essential to start with a very clear idea as to the improvement aimed at, such as disease or climatal resistance, high yielding, and so on. The details of the work are presumably similar to those given by **Shamel**, but we gather that the strains would not be compared until uniformity had been reached in the progeny rows; when this is obtained it is assumed that the strains are pure. Meanwhile a careful study of the characters of the strain can be made, a study which needs a considerable period of time. It is emphasized that this class of work is not purely mechanical and empirical, but that it can only be done with advantage by one who is gifted with the correct disposition, as some of the characters "cannot be seen but must so to speak be felt"; this point of view of the author is somewhat at variance with the wide range of workers required under the Shamel scheme. The author illustrates his paper with useful diagrams, the one on bud selection being made up of miniature stake labels such as he suggests should be adopted in the work.

C. A. B.

Sir **Charles H. Bedford**, LL.D., D.Sc., in a paper on industrial and power alcohol delivered before the World Power Conference at Wembley Exhibition, London,[1] expressed the opinion that when all alternatives of producing motor spirit had been examined one was forced to the conclusion that alcohol is the main hope of the future as a liquid fuel for supplementing the waning supplies of petrol. It is the only material, supplies of which should be inexhaustible. But so far no process has been elaborated which can be stated to be capable of producing alcohol from waste cellulosic materials with certain economic success, and the same can be said of synthetic processes, e.g., ethylene and acetylene. Consequently sugary and starchy materials are now the only stand-bys, and are likely to be for some time to come.

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[1] *Chemical Trade Journal*, 1924, 1938, 75, 29, 61.

The Sugar Industry in China.

By S. HORI, Japan.

If a time should come, when the sugar industry would prosper in China with her extensive tracts of arable land both for cane and beet, and also with a vast supply of cheap and efficient labour, would it not sound an alarm to the supply and demand of the sugar world? China with 400 million inhabitants will fairly require and could herself easily dispose of at least two million tons annually; the United States with only one-fourth that population consumes more than double that quantity. If the prosperity and purchasing facilities of the latter people represent the right scale of demand, why should the people of China with their enormous resources of natural wealth in land and sea always stand below the level of general average? The present production of sugar in China is roughly estimated at 4,500,000 piculs (about 267,800 tons), and the annual import at 5,188,000 piculs (about 308,800 tons), the total being 9,688,000 piculs. This amount averages *per capita* a consumption of 3·22 lbs. When the Chinese abstain from opium smoking, this amount will at once be increased two or three-fold, for the bodily strength and energy must be kept up by sweets, which are the main substitute for opium at present. Opium is, doubtless, a bane to the wealthy as well as to the poorer classes of people in China. A prohibition law exists, but the actual administration is neglected. But the social conditions are being steadily improved by the universal diffusion of education, so there is every hope of abstinence in the end from this insidious vice.

In the decade since the Great War began, most of the foodstuffs have been considerably raised in price, and have led the way to the preparation of a great variety of other foods, in which sugar is an important constituent, and as the demand is steadily improving, the use of sugar is largely increasing by the incessant introduction of wine, other beverages, and confectioneries. Of the 267,800 tons of home-made sugar, nearly 99 per cent. is cane, which is chiefly brown sugar, prepared by an old process with stone-rollers and open kettles; the remaining 1 per cent. only is beet sugar, produced by three factories, one in Harbin, one in Mukden, and one in Tsinan.

Once improvement and development of transport reaches a certain stage and the Government wakes to the possibilities, the production in China of cane sugar will greatly increase, and will improve to such an extent as to offer competition to the world market. The province of Szechwan produces nearly 65 per cent. of the cane sugar at present, and it hopes to become the greatest sugar-producing district in future, the fertility of its soils, the conditions of its warm climate, and the abundance of its population (40 millions), guaranteeing its pre-eminence in this respect. But it is at present hindered by its unfavourable location (too far inland) which renders transport extremely difficult. If we consider only climatic and soil conditions, the provinces of Kiangsi, Fukien, Kwangsi, and Kwangtung, with an aggregate area of 300,000 sq. miles and a population of 62 millions, are looked upon as the other most suitable districts for cane; indeed, the remaining 35 per cent. is produced in these provinces at present.

But in order to bring these districts up to the general level of improvement in the process of manufacture, there are many obstacles or controversies in the way of centralization and adaptation. To break up new land and plant canes is very simple, but to convert the rice and other grains, or vegetable fields into new crops like cane, must give rise to various difficulties of overcoming ingrained customs and economic relations between farmers, compradores, and merchants. This change could only be carried out by the strenuous efforts of the promoters and the Government combined.

The only refining plant now existing in China is that of Jardine Matheson's Co. in Hong-Kong, though two more refineries are now in course of establishment in Shanghai, one of which is Mah's refinery, run by a noted Chinese confectioner in Shanghai, and the other Ming-Hua, to be run by one of the Japanese sugar companies. The two plants are expected to commence operations only from next year, each with a daily capacity of 100 tons raw sugar.

The refined sugar imported into China comes chiefly from Hong-Kong, though Japan is also an exporter. The grades of sugar are various, dry granulated sugar being used only among higher classes of people, and in the southern districts, where the climate is comparatively wet; whereas moist sugar is commonly prevalent in the northern parts, where the climate is usually very dry. To keep an appropriate moisture in sugar and to prevent lumping and deterioration, much energy and experiment have been expended by the refiners in Hong-Kong and Japan, so that comparatively little complaint comes from sugar merchants at present.

The present market price is 12·75 Chinese silver dollars for 100 lbs. of white, and 12·00 dollars for brown sugar, the difference being only 75 cents, which means the general demand is mainly for inferior grades. But due to the progress of social conditions, the use of brown sugar is steadily declining in favour of refined granular grades, so the time is approaching when more refining plants will be needed in China, wherever labour and coal are easily accessible.

While the cane sugar industry of China dates back to times immemorial, beet sugar is only a very recent acquisition. In 1907 some German contractors introduced beet sugar machinery for working 300 tons per diem, and established a factory in association with Chinese in Hunan, near Harbin. But owing to a deficiency of beets and to financial depression, it did not work with profit, and operations were stopped many years before the Great War. During the War the factory fell entirely into the hands of the Chinese, and since then, thanks to a subsidy from the Manchurian Government, has been restored to activity, and is at present said to produce all the local demand.

In 1916, during the War, Japanese sugar "narikin" secured a concession from the Manchurian Government, and opened a factory in Mukden, but the beets being cultivated at the inexperienced hands of Chinese farmers, their supply was not sufficient to cover the factory capacity of 500 tons, and experiencing a more or less short supply every year, the promoters resorted to the refining of Java raw sugar. It is only two years ago that the supply of beet at length reached the demand; and now the sale of their products has gradually extended to a part of Siberia, so they have decided to build another 500-ton factory at Tie-Lin.

Four years ago, a Chinese syndicate at Peking, called the Puyi Industrial Co., undertook to start a beet sugar factory in Tsinanfu, Shantung Province. This is an ideal model of a beet sugar factory working 500 tons per diem. The general equipment of the machinery and the process of manufacture are designed and controlled by foreign experts and well educated native engineers. So far, however, the short supply of beets here again gives rise to unprofitable operation. The soil consists of alluvials of the big Huang-Ho valley, and there is no doubt of its adaptability for beet; but the deficiency of organic substances and potash manures retards the full development of the roots, and the farmers complain of the small quantity of their harvest. The climate is not said to be ideal for the cultivation, the weather in the sowing season being too dry and they have no facilities for irrigation; they must therefore wait till the rainy season which comes late in May to June. This delays the completion of the beet's growing period till the middle of November, when the frost comes and forces it to mature. As the soils lack potash, the size of the roots is naturally very small, but the tissue is very compact and soft, containing less fibre and a high purity of juice. From the results of the last year's campaign, we learn that the average sucrose content was 15·83 per cent. and the extraction 12 per cent. The quality of beet could be much improved by the application of artificial fertilizers, which are at present entirely unknown to farmers.

Any impetus to guide them to improve the quality of their roots and increase their crops means satisfaction both to the factory and to the farmers, and such ought to be supplied by the Government. But the interest of the latter lies solely in the exclusion of other factories from certain adjacent districts, thereby avoiding useless competition. This kind of precaution may become necessary in future, when the farmers acquire the full knowledge of beet culture and acknowledge its profitableness, but at present, when there is but scanty prospect of beets being grown, no rival would dare to establish another factory in the neighbourhood. The factory made loans to the farmers for the first two years, and this induced the farmers to promise to grow extensive areas under beets. But what was the result? Breach of contract and neglect of all care, to the disappointment of the factory. This year, the factory has introduced a lottery in the place of the loan system, according to which anyone who plants beet is entitled to draw one lot for one *muh* (about one-sixth of an acre), provided the beet fields are actually well tended and have more than 3000 plants to one *muh*. The first lot drawn will be 3000 *tiau* (about $800); the second and third lots each 1000 *tiau* (about $266); the next five lots each 200 *tiau* (about $54); and so on, the smallest being $4 for four hundred lots. This sort of encouragement seems to be a suitable one for the speculative character of the natives, and is said to be very promising in inducing them to cultivate a new plant like beet.

But unless the Government intervenes to encourage them with some further means of protection, it will take some years yet before the farmers acquire a full knowledge of beet cultivation to the satisfaction of the factory. In view of this, the factory has decided to carry on sugar refining in summer, and is preparing to start operations in a short time.

In conclusion, I should like to suggest to the Chinese Government and its people that they organize special measures for the encouragement and protection of the sugar industry, and allow foreign capital and technical knowledge to be freely introduced into the country, and at the same time they send their students to foreign countries in order to study at first hand this industry in all its technical branches. They will be wise to abandon the timid and useless idea of being subjugated by the invasion of foreign capital. This last becomes eventually their own possession.

According to the *Morning Post*, the Economic Committee of the Council of Ministers at Warsaw has granted permission for the export of 150,000 tons of sugar. This, it is said, will enable the sugar industry to obtain an immediate loan in England amounting to £1,500,000, as well as to secure another million in the Autumn.

Production and Export says that last February a consignment of Australian sugar—the second in the history of the industry—arrived in England. It consisted of 62,370 casks and 62,370 sacks of raw sugar. But in view of the big reduction in the preference it is a matter of speculation when the next consignment will be commercially feasible.

Report on a Preliminary Investigation of the Colloids of Cane Juices and Molasses.*

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REVIEW OF LITERATURE ON THE SUBJECT.

Although so long neglected, the important effects of colloids in the manufacture of sugar are slowly being recognized. GEERLIGS,[1] WIJNBERG,[2] DEERR,[3] SCHNELLER,[4] PECK,[5] ZERBAN,[6] BREWSTER and RAINES[7,8] and HELDERMAN and KHAINOVSKY[9] and EGETER[10] have all emphasized the necessity of viewing the clarification of cane juice from the colloid-chemical standpoint. This is obvious when we consider that the substances responsible for high viscosity and also the colour of cane products are colloidal. High viscosity of molasses and massecuites means slow boiling in the pan, the work of the boiling-house being congested, with the result that massecuites are discharged too soon and a low recovery of available sucrose is obtained. Moreover, by their protective action it is probable that the colloids keep in solution some of the sucrose that would otherwise crystallize out. Again colloids are responsible for the various precipitates which settle out in the syrup and cause scale in the evaporator. It is hardly necessary to dwell on the importance of colour in cane products when it is desired to manufacture a white sugar.

Little work has been attempted in the past on the subject of the colloids of the cane. DEERR[3] showed that the cane colloids were emulsoids and carried a negative charge; and that the colloids responsible for a visible turbidity were coagulated on heating the juice to 88°C. and did not resume the colloidal state on cooling. He thus concluded that cane juice colloids were irreversible towards heat. Furthermore, DEERR states "the colloids when coagulated by the addition of alkali resume the colloidal state on neutralization of the alkali, and hence the colloid-state is reversible with reference to alkalinity and acidity." Summarizing, he states that "the clarification of cane juice is essentially a precipitation of matter in the colloid state, since much more than half the weight of the precipitate obtained in the usual process of clarification consists of matter originally in the colloid state."

PECK[5] mentions tannins, albuminoids, and pectins as comprising the colloids of cane juice and hints at the existence of silica in colloidal state[11,12,13]. No experiments, however, were carried out to isolate the cane colloids. Similarly EGETER[10] states "in colloidal solution there are gums, pectins, proteins, silicic acid, clay colouring matter, etc., and in coarse dispersion one finds clay, cane wax, particles of bagasse and also air." Again, no attempt was made to isolate and substantiate the existence of these colloids.

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* Report No. 13, made to the British Empire Sugar Research Association. Here published in slightly abridged form by kind permission of the Association.

[1] GEERLIGS. "Practical White Sugar Manufacture." (1915) p. 62-63.
[2] WIJNBERG. *I.S.J.*, (1915), **17**, 73.
[3] DEERR. *I.S.J.*, (1916), **18**, 502-506; 558-562.
[4] SCHNELLER. *Louisiana Planter*. (1916), **56**, 44.
[5] PECK *I.S.J.*, (1919), **21**, 70
[6] ZERBAN. *Louisiana Bulletin*, No. 173 (1920).
[7] BREWSTER and RAINES. *J. Ind. Eng. Chem.*, (1921), **13**, 921.
[8] BREWSTER and RAINES. *J. Ind. Eng. Chem.*, (1921), **13**, 1043.
[9] HELDERMAN and KHAINOVSKY. *Archief*, 1921, 1229 and 1344; *I.S.J.*, **1922**, **24**, 89.
[10] EGETER. *I.S.J.*, (1923), **25**, 133,
[11] MULLER. *I.S.J.*, (1921), **23**, 579.
[12] BIRD. *Louisiana Planter*, (1922), **69**, 61.
[13] FARNELL. *I.S.J.*, (1923), **25**, 358.

Zerban[6], who conducted many experiments in the laboratory and factory on the "non-chemical" clarification of cane juice by a kieselguhr-carbon method, found that boiling with kieselguhr ("Filter-cel") had some effect in the removal of non-sugars, but the subsequent addition of active carbon ("Norit") appeared to absorb very much more of these substances than did the kieselguhr. The colouring matter was not affected to any extent by the "Filter-cel" treatment, but all could be removed by the use of a sufficient amount of "Norit," and in general the colour of juice clarified by the kieselguhr-carbon method compared very favourably with that of juice clarified by the method common in Louisiana—initial sulphuring and subsequent addition of lime.

Paine and Walton[14], [15] studying the effect of different samples of kieselguhr in their effect on the clarification of cane juice found little difference in the removal of colloids provided a sufficient amount was used. By heating juices and filtering through kieselguhr there were removed all colloids of such dimension as to give a visible turbidity, while the subsequent use of carbon eliminated colloids that imparted no visible dimness to the liquid. The same authors found that with an artificial juice made from cane syrup (which, presumably, had been concentrated from clarified juice), only 10-15 per cent. of the colloids originally present were removed by kieselguhr, but "Norit" removed nearly all. From this it looks as if the kieselguhr is chiefly instrumental in removing the protein which has been coagulated by heat, while the carbon absorbs other colloids in the juice, such as pentosans, which are not precipitated during defecation. In the diluted syrup used by Paine and Walton the coagulable protein would have previously been very largely removed by boiling.

Helderman and Khainovsky[9] showed that by the addition of infusorial earth (kieselguhr) and "Norit" to various diluted molasses (defecation, defecation-sulphitation and carbonatation), a general decrease in viscosity was shown and the effect of "Norit" was usually more evident in this respect than that of the infusorial earth. The absorption of "gums and pectins" (alcohol precipitate) was also greater with "Norit" than with kieselguhr. Actual enumeration of the colloidal particles by counting in the ultra-microscope did not give very conclusive results, since the "Norit" itself appeared to furnish suspensoid colloids which have little effect on the viscosity.

Wijnberg[2], discussing the capacity of "Norit" to remove "gums" from juices, mentions that the "gums and pectins" in cane juice "or whatever the slimy substances may be called," are absorbed more strongly in acid than in alkaline solution. His explanation of this phenomena is not very satisfactory, and he states that pectins are colloidal substances in pseudo-solution, slightly acid in reaction and readily dissolving in alkalies. While this may be true of the pentosan which constitutes cane gum [16,17] it certainly does not apply to the true pectin of the cane.[18] Wijnberg further states that in acid solution the dissociation of the "pectin" is suppressed, and the colloids pass from the soluble to the gelatin state being precipitated and transformed into larger molecular groupings which may be observed ultra-microscopically.

Brewster and Raines[8] confirmed Wijnberg's observation that the best decolorization with "Norit" was obtained in slightly acid solution, finding much more colour absorbed at pH4 than at pH7 (neutral) or at higher values (alkaline).

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[14] Paine and Walton. *Science*, (1921), **53**, 266; *I.S.J.*, (1921), **23**, 700.

[15] Paine and Walton. *I.S.J.*, (1921), **23**, 50.

[16] Hazewinkel and Steuerwald. *Archief*, (1913), **19**, 313.

[17] Steuerwald and Van der Linden. *Archief*, (1914), **22**, 1033.

[18] Farnell. *I.S.J.*, (1923). **25**, 248 and 630.

They recommended heating the juice mixed with the carbon to the boiling point, adding phosphoric acid to pH 4, allowing a short time for action and then neutralizing back with milk-of-lime to pH 6·5. Their claims have been covered by a recent patent.[19] No actual measurement of the percentage of colloids removed at different pH values was recorded in either of the papers of these authors. As an explanation of Wijnberg's observation they quoted the conclusions of Perrin[20], and Mayer, Schaffer and Terroine[21] that the size of the particles of the colloid is a function of the reaction of the medium, and in a very general manner the addition of traces of acids to the solution of a negative colloid has the effect of increasing the size of the particles. Thus, presumably, more of the colloids can be removed by filtration through the carbon.

It occurs to the writer as an alternative explanation of the maximum absorption of colour at pH 4, that the phenomenon is connected with the iso-electric condition of the ampholyte colloids of the cane juice. Since Deerr[8] found that the colloids of cane juice migrated to the anode at the natural acidity of the raw juice (presumably at pH 5) it follows that the iso-electric condition of those colloids must be at a point on the more acid side of pH 5; Sorensen finds for albumin that the iso-electric point is at pH 4·8, while Pauli obtained for glutin the iso-electric point at pH 4·1 and Cohn found the iso-electric point for globulin at pH 4·0. At the iso-electric point the hydration of the proteins and amino acids is at a minimum, and Abderhalden and Fodor[22] have found that the absorption of amino acids, polypeptides, and proteins by charcoal is at a maximum when their hydration is at a minimum. Therefore, one would expect the absorption should be greatest at the iso-electric point. It seems very desirable to determine the iso-electric points of the colloids as they occur in cane juices.

Only in two cases (Paine and Walton[14] and Brewster and Raines[7]) have the colloids in cane juice been isolated by means of dialysis. Paine and Walton used a collodion sac for dialysing an artificial juice made from cane syrup, but they do not appear to have examined the non-dialysable substance. Brewster and Raines studied the effect of carbons, kieselguhr, and the sulphur-lime process on the colloids of cane juice. They showed that raw juice, freed from suspended matter by centrifuging, contained about 0·18 per cent. of colloids which they determined by dialysis through collodion membranes. Filtration of the boiled juice through kieselguhr removed about 80 per cent. of the colloids in the raw juice, and subsequent application of carbon took out a further quantity, making the total amount removed about 92 per cent. of the original. Factory experiments showed that the Louisiana sulphur-lime process (initial sulphuring to pH 3·8, liming back to pH 6·8, then boiling and subsiding) removed on the average about 89 per cent. of the total colloids.

The colloidal matter remaining after the kieselguhr carbon treatment contained about 10 per cent. of ash, that from the lime-sulphur process about 35 per cent. The authors state that juice clarified with about 2 per cent. of its weight of kieselguhr filtered rapidly and gave a brilliant clear, though coloured filtrate. This clarified juice when dialysed, and the non-dialysable substance evaporated to dryness, gave a solid residue sometimes having a gelatinous appearance and often being nearly colourless. It was also noticed that in dialysing cane juice a great deal of the colouring matter passed through the membrane, some of the colour being absorbed in the membrane itself.

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[19] Brewster and Raines. U.S.P. 1,447,461; *I.S.J.*, 1923, 25, 390.
[20] Perrin. *J Chim. Phys.* 1904-5.
[21] Mayer, Schaffer and Terroine. *Compt. Rend.* (1907), 145, 918.
[22] Abderhalden and Fodor *Chem. Abs.* (1920), 14, 3678.

After reviewing the work which had already being done on the cane colloids, it was decided to experiment principally upon the colloids present in factory molasses, the investigation being started after the close of the grinding season when no ripe cane was available. Later, however, observations were extended to the juice of some 11 months cane which was ground in a hand mill.

EXPERIMENTAL ISOLATION OF CANE COLLOIDS BY DIALYSIS.

The dialysing sacs were made from ether-alcohol solution of collodion, since it appears from a study of the literature of diffusion and dialysis that this substance furnishes the most satisfactory membrane. Recently BROWNE[23] has found that a membrane made from 6 per cent. collodion solution retained the most tannin when used for dialysing tannin extracts. Accordingly, a 6 per cent. membrane was used for dialysing cane products. Large test tubes of 100 c.c. capacity were used for making the collodion membranes by the method described in the numerous text-books of practical colloid chemistry.

For dialysing in 100 c.c. sacs, 75 c.c. of juice and 25–30 grms. of molasses were found convenient quantities. Owing to osmosis, it was found impossible to prevent dilution of the molasses. The safest way of introducing the molasses was to weigh out the required amount in a small beaker, and then pour it into the sac, which was partially immersed in water in a large 1600 c.c. beaker. The actual weight of the molasses introduced was found by difference in weight of the small beaker. The introduction of the juice into the sac from a pipette presented no difficulty.

The most convenient procedure in dialysing was found to be as follows: The dialysis began in the afternoon against running tap water, the sac being suspended by cotton thread in the large beaker which was fitted with a constant level syphon apparatus. A slow stream of tap water circulated through the beaker which was placed on the boiling water-bath, the temperature of the circulating water being thus maintained at about 80° C. Since the petrol-gas generator did not work overnight, the dialysis had to continue against cold running tap water. In the morning the beaker was heated again, and at mid-day the tap water was turned off and replaced by rain water, which was subsequently changed every two hours. Dialysis proceeded against distilled water over the second night, and in the morning the water was changed again. At mid-day dialysis was stopped, most of the water syphoned off, and a small hole then pierced in the bottom of the sac which was thoroughly washed with hot distilled water. In this way all the non-dialysable substance would be collected. Care was taken during the changing of the water not to syphon off more than about ⅔ at once, so as to avoid the breaking of the sac.

A great increase in the rate of dialysis was observed by dialysing against hot water. With the juices examined, complete dialysis was obtained after 24 hours' hot dialysing, whereas against cold water it was necessary to continue the dialysis for 120 hours.

OBSERVATIONS MADE DURING DIALYSIS.

In all cases a great deal of colouring matter passed through the membrane, and in addition the membrane itself adsorbed some of the colour. After dialysing, the molasses became a dark-brown red. Now part of the colouring matter of molasses is due to caramel, and part to the ferric salt of a poly-phenol which ZERBAN[24] showed to be a true catechin tannin, and present chiefly in the cane tops. GRAHAM[25] found that part of the caramel, namely "caramelan" and "caramelen" could be dialysed away, leaving the third constituent "caramelin" behind. The caramel of the molasses should consist principally, if not entirely, of "caramelan" and "caramelen"; since, for the production of "caramelin," sucrose has to undergo the drastic treatment of being heated to 180–190° C. until a loss of 22 per cent. in weight is obtained.

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[23] BROWNE. *J. S. Chem. Ind.*, (1923), 12, 989A.
[24] ZERBAN. *J. Ind. Eng. Chem*., (1919), 1, 1034.
[25] GRAHAM. *J. Chem. Soc.*, (1862), 15, 258.

The colour which was adsorbed in the collodion membrane was due to the "ferric tannate." Recently Miss PRICE[26] has described a qualitative method of detecting tannins and distinguished catechin and pyrogallol tannins. Her method is based on the absorption of the tannin on a membrane of gold-beaters skin and subsequent treatment with ferric chloride, thus producing a stain which in the case of a pyrogallol tannin is completely decolorized by dilute hydrochloric acid, while with a catechin tannin the reddish stain remains unchanged. When a portion of the collodion membrane used for dialysing molasses was treated with dilute hydrochloric acid, no decolorization occurred, not even on boiling. A ferric salt of a pyrogallol tannin (commercial tannic acid) was then made and dialysed in a collodion sac. Much of the blue colour came through and the sac itself adsorbed the colour. In this case, however, treatment with hydrochloric acid decolorized the membrane completely. Thus, additional evidence is afforded to Zerban's observation that the cane tannin belongs to the catechin class.

In all cases when dialysing juices and molasses, a dark precipitate came down after some time. This may have been due to some of the albuminoids which were not coagulated during manufacture. Other proteins can also be coagulated by dialysis.[17]

Table I.

	Non-dialysed Substance, per cent Molasses.	Pentosan, per cent Molasses.	Pentosan, per cent non-dialysed Sub.	Pentosan undialysed, per cent	"Protein," per cent. Molasses	"Protein," per cent non-dialysed	"Protein," undialysed, per cent
(*a*) Molasses A, 47 hours cold dialysis, tap water.. ..	1·64	0·56	7·84	23·9	1·97	25·3	21·1
(*b*) Molasses A, 17 hours hot rain water	2·19	0·56	9·53	36·4	1·97	13·4	14·8
(*c*) Molasses A, 48 hours hot distilled water .. .	1·17	0·56	10·87	22·6	1·97	14·7	9·7
(*d*) Molasses A, 64 hours hot distilled water	1·40	0·56	10·27	25·7	1·97	12·5	8·8
(*e*) Molasses B, 19 hours hot tap water..	1·79	0·33	5·96	32·0	1·52	14·0	16·4
(*f*) Molasses B, 19 hours hot rain water	1·63	0·33	6·80	33·5	1·52	16·4	17·6

The colloidal solutions, obtained after dialysis had finished, were a dark grey colour and quite opaque. For subsequent analysis it was not found possible to make the solution up to a known volume, and withdraw aliquot portions owing to the precipitate already mentioned. Consequently, the solution was transferred to a weighed glass evaporating basin and brought to dryness on the water-bath. After drying for four hours and obtaining the total weight of the non-dialysable substance, the dark dry matter was scraped with a nickel spatula into a stoppered weighing bottle. Portions were then weighed out for analysis. The two principal constituents determined were "protein" ($N \times 6{\cdot}3$) and pentosan. The protein was determined by Kjeldahl's method, the pentosan by the Tollens-Krober

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[26] PRICE (Miss). *J. Chem. Soc. Ind.*, (1923), 42, 1106 R.
[17] OSBORNE. "The Vegetable Proteins," 1909, p. 35.

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method. In addition, ash was determined on a few samples, and "wax" was determined in one case.

Results of the Dialysis Experiments.

The results of dialysing some molasses are given in Table I, Molasses A being from a defecation factory with 14-roll mill and shredder; and Molasses B from a defecation factory with 11-roll mill and no shredder.

It will be seen from Table I that the agreement is not as good as could be desired. In this sort of work the most one can hope for are proximate results. The permeability of the sacs may have varied in the different cases, though the conditions of their construction were as similar as possible.

With Molasses A, experiments (*a*) and (*b*) both show insufficient dialysis. The agreement in the case of Molasses B is more satisfactory. Averaging the results of (*c*) and (*d*) in the case of Molasses A, and (*e*) and (*f*) in the case of B, we obtain the following figures for the per cent. of pentosan and protein which would not dialyse:—

Table II.

	Pectin, per cent. Molasses.	Pentosan, per cent. Molasses.	Pentosan, undialysed, per cent.	"Protein," per cent Molasses.	"Protein," undialysed, per cent.
Molasses A	0·48	0·56	24·1	1·97	9·3
Molasses B	0·63	0·33	32·7	1·52	17·0

It was found impossible to decide whether the pectin (possibly in the form of calcium pectate) or pentosan (as xylan), or both, remained undialysed. Since the colloidal solution after dialysis already contained a precipitate, there could be no attempt to isolate the pectin as calcium pectate.

In the first column of Table II is recorded the pectin originally contained in the molasses, which was determined by the method already described by the writer elsewhere.[28] This pectin yields a certain amount of furfural when treated as for pentosan determination by the Tollens-Krober method. It seems likely that the "pentosan" recorded in the analysis of the non-dialysable substance from molasses is really due principally to the pectin, for the figures in the third column (pentosan undialysed per cent.) are roughly proportional to the figures in the first column (pectin, per cent. molasses). Anyhow, it is obvious from Table II that much of the "pentosan" and "protein" of the original molasses passed through a collodion membrane. The "protein" figures are only relative, since they represent besides true protein, amino acids and amides, also ammonia and nitrate. Browne and Blouin[29] found the nitrogen of the cane to be distributed as follows:—

Table III.

	Cane, per cent.	Total Nitrogenous Bodies, per cent.
Albumin (coagulable)	0·059	10·0
Nucleins („)	0·040	6·8
Albumoses and peptones (non-coagulable)	0·033	5·6
Amino acids (non-coagulable)	0·145	24 7
Amino acids amides (non-coagulable)	0·232	39·5
Ammonia (non-coagulable)	0·008	1·4
Nitric acid (non-coagulable)	0 071	12·0
Total, nitrogenous bodies	0·588	100·0

Of the above nitrogen compounds found in Louisiana Purple cane only the albumin and nuclein are truly colloidal, the albumoses and peptones being on the border line. Pregl[30] has shown that peptones dialyse easily. Therefore, only some 20 per cent. of the nitrogen would be retained on dialysis. Furthermore, during the defecation by lime and heat, much of the albumin and nuclein are removed by coagulation, which accounts for the small amount of nitrogen found in the non-dialysable fraction of factory molasses.

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[28] Farnell. "Report on the Pectin and Pentosan of Cane Juice." *I.S J*, 1924, 333.

[29] Browne and Blouin. *Louisiana Bulletin*, No. 91.

[30] Pregl. *Chem. Abs.*, (1915), 9, 3263.

The results of dialysing some juice (from bamboo cane ground in a hand mill) are given below in Table IV.

Table IV.

	Non-dialysable Substance (1) per cent. Juice, (2) per cent Brix.	"Protein," (N × 6·3) per cent. Brix.	"Protein, per cent. non-dialysable Substance.	"Protein' undialysed.
(*a*) Juice (raw), 25 hrs., hot distilled	(1) 0·031	—	—	—
	(2) 0·20	0·73	29·4	8·1
(*b*) Juice (raw), 120 hrs., cold distilled	(1) 0·032	0·73	30·3	8·8
	(2) 0·21	—	—	—
(*c*) Juice, boiled, subsided, and decanted	(1) 0 0078	—	—	—
	(2) 0 0575	0·60	10·8	1·0

This juice may be considered similar to the high purity first expressed juice from a factory mill. The total amount of non-dialysable substance is seen to be very small, i.e., 0·03 per cent. of the raw juice. The factory juices examined by BREWSTER and RAINES[7] contained from 0·13-0·23 per cent. non-dialysable substance. When studying the pectin and pentosan of this hand-expressed juice,[28] it was found to contain very much less pentosan (i.e., 0·036 per cent. Brix.) than the factory juice analysed by HAZEWINKEL and STEUERWALD,[16] which contained pentosan to the extent of 0·23-0·38 per cent. Brix. Sufficient juice could not be dialysed for a pentosan determination to be made on the non-dialysable fraction.

It will be seen that 75 per cent. of the original colloidal substance was removed by merely boiling the juice at its natural acidity. This agrees with Deerr's observation.[8] About 88 per cent. of the non-dialysable "protein," i.e., albumin and nuclein, could be coagulated by heating.

The ash content of the non-dialysable substance in juice (B) was found to be about 10 per cent.; DEERR found 4-6 per cent.; and BREWSTER and RAINES 6-14 per cent. There was not enough ash available to determine its silica content.

The ash content of a portion of the undialysable substance from Molasses A (see Table I) was found to be 20 per cent. This ash contained silica, but again there was not enough to determine its amount with any accuracy. The non-dialysable substance from Molasses B contained also about 20 per cent. of ash.

It is interesting to find that recently LING and NANJI[31] have shown that amylo-pectin, one of the constituents of starch, contains silica, probably in the form of a hemicellulose. Similarly in their study of agar, SAMAC and SSAJEVIC[32] found silica in some form of combination. They regarded agar as a gelose sulphate or perhaps silicate in part. Silica certainly does appear to exist in some colloidal combination in cane juices and molasses, as has been suggested by MULLER.[11] It would be necessary to dialyse large quantities in order fully to study this question.

WAX IN THE NON-DIALYSABLE PORTION.

Since a considerable amount of wax had previously been isolated from the alcoholic precipitate from some molasses, it was decided to dialyse a larger quantity than usual and to examine the non-dialysable portion for the presence of wax.

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[31] LING and NANJI. *J. Chem. Soc.*, (1923), 123 and 124, 2666.
[32] SAMEC and SSAJEVIC. *Chem. Abs.*, (1922), 16, 1401.

About 50 gms. of Molasses A were dialysed against hot tap, then distilled water. Dialysis proceeded for 58 hours; the contents of the sac were collected and dried on the water-bath; 0·63 gm. of the dried substance was transferred to a small pleated filter-paper, and then extracted in a Soxhlet apparatus for four hours with 150 c.c. redistilled alcohol. The pale yellow alcoholic extract was then evaporated down under reduced pressure and the wax further dried at 103°C., to constant weight. The weight of wax obtained was 37·2 per cent. of the non-dialysable substance, and corresponded to 0·52 per cent. of the original Molasses A. Pressure of other work prevented wax determinations being made on the non-dialysable substance from Molasses B, and also on the actual molasses.

The presence of this wax in the molasses is interesting. It is probably in the form of an emulsion. GEERLIGS[33] mentions that the scale in the first vessel of the evaporator contains a relatively large proportion (40 per cent.) of wax. He also states that the froth produced on blowing up molasses with steam contains 1·6 per cent. of wax.

The effect of this wax cannot but be detrimental to the production of a sparkling sugar, and further investigation on this point is very necessary.

The presence of a catechin tannin in the non-dialysable substance of juices and molasses has already been mentioned. Direct colour tests with iron salts, etc., failed, as the tannin was already in combination with iron. Lime water added to some of the colloidal solution from molasses gave a yellow precipitate, as also did bromine water. These two tests were both recorded by ZERBAN[34] as characteristic of catechin tannin.

The approximate composition of the undialysable substance from the two samples of molasses investigated is given below in Table V.

Table V.

	UNDIALYSABLE SUBSTANCE FROM:	
	Molasses A.	Molasses B.
Pentosan	10–11%	6–7%
"Protein" (N × 6·3)	12·5–14·5	14–16
Wax	37·0	Not determined
Ash	20	20
Undetermined (including tannin, etc.)	20·5–17·5%	60–57%
Total	100%	100%

The following lines of investigation are indicated:—(1) The effect of various methods of manufacture on the colloids of the cane. (2) The determination of the iso-electric points of the ampholyte colloids present in the juice. (3) The examination of the wax present in juices, syrups and molasses and its effect on manufacture. (4) Isolation of the colloidal silica-containing substance in juice.

Notice has been given that all denatured alcohol produced in the United Kingdom must now consist of:—90 per cent, of spirit; 9·5 per cent. of methyl alcohol; and 0·5 per cent. of crude pyridine; and must contain in addition 0·375 per cent. of approved mineral naphtha or petroleum oil, and not less 0·025 of an oz. of methyl violet for each 100 gall.

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[33] GEERLIGS. "Cane sugar and its manufacture." (1909), p. 208-266.

Do Sugar Beets Pay ?

By **OSWALD WILSON**,

Editor, Sugar Beet Journal, San Francisco, California.

Sugar Beets stand at the head of all crops of the temperate zone in the amount of energy that can be produced in a given area. They are the most efficient of all machines for the fixation of solar energy in a form so that it can be used in the human body to produce muscular power. An acre of sugar beets may produce nine million calories of energy ; more than twice as much as potatoes ; three times as much as barley or oats, and more than four times as much as wheat or rye. The sugar beet can be raised by the white man in the temperate zone by free and high-priced labour, using scientific methods and power. It will run out the cheapest hand labour. As solar energy is necessary to the well being of every man, woman and child, it is useful to enquire whether sugar beet cultivation pays.

The per capita consumption of sugar in the United States has steadily increased from 32·7 lbs. in 1870, when the first beet sugar factory was established at Alvarado, California, to 102 lbs. per capita in 1922, when there were 106 beet sugar factories in operation. In 1870 the United States consumed 23·3 per cent. of all the sugar produced in the World, and in 1922 had increased to 30 per cent., even the great increase in domestic beet sugar could not meet the increase in consumption. The United States consumes more sugar than any nation and hence has more solar energy. However, the accumulated experience of man, on the whole, has developed in him, unconsciously, a higher and higher appreciation of sugar's real value as a food until in the modern scientific era we have learned why this ever enlarging consumption has taken place and can now understand that as source of energy in the human diet sugar occupies a leading place.

According to generally accepted views, our diet should ordinarily consist of about 60 per cent. carbohydrates, 30 per cent. fat, and 10 per cent. protein. The number of calories contained in an adult's daily food is variously estimated at from 1800 to 3500 ; taking 2500 as a fair average this would represent 1500 as coming from carbohydrates. A pertinent question is—what proportion of this should be supplied by sugar ? At present the average consumption of sugar in the United States is about 103 lbs. per head per annum. This is equal to 4·39 oz. per day ; since sugar develops 1800 large calories per lb. this amounts to 510·3 calories per day or 20·4 per cent. of the total energy derived from a 2500-calory daily ration. Australia and New Zealand have consumed about 130 lbs. per capita per annum or the equivalent of 5·7 oz. per day, equal to 25·5 per cent. of the total energy supplied by a similar ration.

The astounding truth develops that if 100 lbs. of sugar supplies one of us with 20·4 per cent. of his yearly food energy, the cost of his entire food, if it could be bought on the basis of sugar at 8 cents per lb., would only be $39·22 per annum, or less than 12 cents per day

A concrete example of what sugar beet pays the farmer, is shown in the official report of the returns per acre of the different crops on the North Platte, Nebraska, project of the United States Reclamation Service, a successful and typical irrigation district. The figures are given in the Table following.

One acre in beets paid as much as seven other crops. It requires 123 hours of man-labour to prepare, plant, cultivate, harvest and deliver an acre of beets. It requires 93 hours of man-labour to prepare, plant, harvest and deliver an acre of wheat. Wheat takes $5·41 of minerals out of each acre of the soil, while beets put humus in and increases the fertility.

Do Sugar Beets Pay?

The irrigated districts of Western Nevada and Eastern California, have the most favourable climate, soil and irrigation for the production of high-grade sugar beets, the average yield being 414 lbs. per ton of beets, with an 88 per cent. purity coefficient. There are 250,000 acres in these districts under irrigation adapted to sugar beet culture and room for 6000 beet growing dairy farmers and 10 beet sugar factories.

AVERAGE GROSS RETURNS PER ACRE, 1922.	$
Sugar beets ($6·30 per ton)	84·32
Alfalfa hay	13·62
Beans	25·03
Onions	66·00
Potatoes	15·37
Wheat	14·74
All crops	21·74
Cotton, Yurma project	49·31
10,614 acres in beets	894·927
75,786 acres in other crops	983·523

The following figures show that sugar beets on the western slope of Colorado were highly profitable in 1923. They also show that money was made at $7 per ton and the additional payments will swell the total received at least one-third more.

NAME.	ACRES.	TONS PER ACRE.	AMOUNT AT $7 PER TON.
Henry Mayr, Antlers	44	13·67	$4,210 00
M. E. Letson, De Beque	16	10·58	1,185·07
Biggs-Kurtz, Factory	3	11·88	249·55
Fred Nickolai	40	11·48	3,214·53
E. B. Kinzer, Factory	8	15·90	890·60
J. R. Stapleton, Factory	8	13·72	768·27
Leonard Else, Fruita	17	18·31	2,179·74
W. H. Flint, Fruit	3·4	19·45	463·14
Ed. Kohls, Fruita	10	18·34	1,284·14
Jess Weaver, Holland	2	16·70	233·77
E. D. W. Bessire, Holland	2	16·87	236·15
Virgil Morris, Hunter	2	16 87	236·15
W. E. Dodds, Hunter	8	19·25	1,077·87
J. B. Roberts, Hunter	14	23·16	2,270 40
T. Hirai, Loma	30·5	15·67	3,346·18
W. H. Cox, Loma	9·5	18·99	1,263·22
J. F. Holt, Loma	7	19·43	952·49
Floyd Tackas, Mack	3	16·03	336·59
Juan Pacheco, Mack	5	17·60	616·18
A. Kizrian, Price, Utah	6	13·11	550·71
Woodward Bros , Rifle	47	15·65	5,151·41
Henry Weaver, Rogers	3	17·49	367·37
B. F. Bain, Rogers	2	14·97	209·67
Joe Beeser, Rogers	5	19·17	671·10
A. K. Foster, Rogers	3	20·28	425·78
Louie Gobbo, Rogers	5/8	30·80	134·81
Fred Wagner, Rogers	8	19·88	1,113·38
Conrad Lind, Silt	31	14·77	3,206·75
W. G. Hinshaw, Sykes	46	19·85	6,390·58
Henry Verraest, Sykes	12	18·17	1,526·82

The above figures only show the amounts received for the sugar and do not take into account the value of the by-products, nor the increased yield of all the other crops following sugar beets, all of which increase the profits of the farmer and at the same time lower the cost of all foods.

While beet sugar contains more solar energy and is sold at a less price than any other food, the manufacturing and distribution thereof offer a safe, stable and profitable investment for capital, and there is a great future for the sugar beet in the United States.

The history of the Great Western Sugar Company is one of the industrial romances and achievements of America. This company was organized in 1901, with a capital of $30,000,000, of which one half is common stock and the balance 7 per cent. cumulative preferred. They operate sixteen beet sugar factories in Colorado, Nebraska, Montana and Wyoming, with an aggregate slicing capacity of 21,900 tons of beets daily. In 1923 this company produced 295,919 tons of standard granulated sugar, practically one-eighteenth of all the sugar consumed in the United States. The annual report of the Company, for 1923 shows:—

Capital Stock	$30,000,000·00
Total Assets	76,063,435·00
Current Assets	46,182,997·00
Surplus	34,699,927·00
Net Profits, 1923	$12,004,333·00

This company has paid regular dividends and at the same time has accumulated a surplus, which would retire their entire capital stock, both common and preferred, at par, leaving the plants paid for and a good working capital besides. A splendid showing for its stockholders.

But this is not all: the Great Western Sugar Company, since its incorporation in 1905, has paid out over $420,000,000—to the farmers for beets, for factory labour, to the railroads for freights, and to manufacturers and others for steel, machinery and supplies. Taxes alone amounted to $35,000,000 or 116 per cent. of its total capital.

The profits earned and the direct benefits to the community in the payments for sugar beets to the farmers, and for labour, supplies, taxes and other items as shown by the report of the Great Western Sugar Company is but typical of all the other big companies.

The Spreckles Sugar Company operating the largest beet sugar factory in the world, at Spreckles, California, slicing 4500 tons of beets daily, in one year earned over $2,500,000 on a $5,000,000 capital.

The American Beet Sugar Company, the pioneer in America, operating six factories in California, Colorado and Nebraska, in five years, shows net earnings of $15,389,297·85. This company has the second largest factory in the world at Oxnard, California.

The Utah-Idaho Sugar Company, started by Brigham Young, head of the Mormon Church, operating 16 factories in Utah, Idaho and Washington, is a very successful company and has played an important part in the material development of Utah and Idaho. In 1917 with 12 plants it had $9,449,730·00 capital and a surplus of $10,031,859·03. To-day the assets are over $40,000,000·00.

This same story could be repeated for every one of the big sugar companies; not only have they earned large dividends for their stockholders, but more important still, they have made the districts, in which the factories are located, successful and prosperous, and thereby have contributed in no small degree to the development and prosperity of the entire Western United States. *Therefore, there is but one conclusion, considered from every angle: Sugar Beets do pay.*

In the House of Commons on July 8th, Mr. W. R. Smith stated that during the last campaign Cantley beet factory produced 8957 tons and employed 795 men, whilst Kelham factory made 4322 tons with 433 men.

Hawaiian Factory Results, 1923 Season.[1]

By E. T. WESTLY.

After remaining stationary, or rather, dropping back a little, for two seasons the 1923 crop in Hawaii shows better factory results than ever before. The total recovery of polarization in commercial sugar per 100 polarization of cane was 88·77 per cent. in 1923. In 1920 the recovery was 87·35 per cent.; in 1921 only 85·86 per cent.; and in 1922 it was 87·02 per cent. It is rather interesting to compare the extractions, mixed juice purities, and the over-all recoveries obtained for these years:—

Crop.	Extraction per 100 Pol.	Mixed Juice Purity.	Commercial Sugar Pol. per 100 Pol. of Cane.
1920	97·45	83·87	87·35
1921	97·43	82·77	85·86
1922	96·98	83·73	87·02
1923	97·23	84·27	88·77

The writer has from time to time mentioned the importance of juice purities, and will again emphasize this point. From the above figures we see that with a lower extraction than in 1920 and 1921 the recovery is much higher in 1923, because the mixed juice purity was higher. In 1923 the reported average Philippine extraction was 94·51 per cent., the average mixed juice purity 84·23 per cent. and the over-all recovery 85·54 per cent. If we compare this with the Hawaiian averages for 1921, we will see that in Hawaii that year with 97·43 per cent. extraction or 2·92 higher than the Philippines, only 0·32 better over-all recovery was obtained.

This was because the 1921 mixed juice purity in Hawaii was 82·77, and the mixed juice in the Philippines was 84·23. How much better the figures agree for both in 1923 is indicated here:—

	Extraction Per 100 Pol.	Mixed Juice Purity	Pol per 100 Pol. in Cane.
Hawaii	97·43	84·27	88·77
Philippines	94·51	84·23	85·54
Difference	2·72	0·04	3·23

Coming back to the factory results in Hawaii during 1923, we will first take up the cane milled. The principal varieties ground were: Yellow Caledonia, 36·3 per cent.; H 109, 30·7 per cent.; D 1135, 11·2 per cent., and Lahaina 8·4 per cent. Five years ago the percentages were: Yellow Caledonia, 42·9 per cent.; H 109, 4·0 per cent.; D 1135, 7·5 per cent., and Lahaina 37·9 per cent. Looking over these figures we see that Yellow Caledonia is slowly losing ground, H 109 is rapidly gaining, and Lahaina is fast going out. D 1135 is gaining slowly.

Taking the quality of the cane milled during 1923 we note that polarization is a little lower than the previous year, i.e., 12·78 in 1923, as against 12·97 in 1922. The fibre was also a little lower in 1923, being 12·82 and 12·95 in 1922. The purity of the first expressed juice, however, was higher in 1923; 87·05 is the average reported for that year against 86·84 in 1922. No doubt the delay between cutting and milling the cane is being reduced in Hawaii. That there is quite a difference in the quality of cane between the different plantations in Hawaii is shown in the following figures:—

	Highest Average reported.	Lowest Average reported.
Polarisation per cent. cane	14·27	10·92
Fibre per cent. cane	15·73	11·68
Purity first expressed juice	89·76	83·60

Average extraction of 97·23 is reported for the 1923 season; during 1922 it was 96·98. Average polarization in bagasse was 1·55, against 1·69 in 1922.

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[1] *Sugar News*, 1924, 5, No. 5, 231–232.

Moisture in bagasse was 41·56 in 1923; practically the same as in 1922 when it was 41·51. Maceration during 1923 averaged 35·12, against 34·75 in 1922; and 2·76 is the average milling loss reported for 1923, a drop of 0·26 from the 1922 average of 3·02.

Higher hydraulic pressures were carried during 1923 than during 1922. The average per linear foot of rollers during 1923 was 66·15, in 1922 the figure reported was 65·19. The slightly higher maceration and greater pressures used in 1923 is no doubt the reason for the better milling results. No factory reported over 99 per cent. extraction during 1923, but five report over 98 per cent. extraction, while the highest reported average by any one mill was 98·88 per cent. New records have been established in milling loss and in bagasse polarization, namely 1·09 milling loss and 0·66 polarization in bagasse. The records before were 1·10 and 0·67 respectively. To average 0·66 polarization in bagasse for a season is a notable performance. Better mill sanitation in 1923 undoubtedly accounts for the 0·18 lower drop from the first expressed juice to mixed juice purity than during 1922.

A few of the factories in Hawaii use extra fuel, but the amount used is gradually being reduced. No doubt in a very few years nothing but bagasse will be used.

Clarification has received more and more attention during the last two years in Hawaii. Of the 37 factories reporting, 23 report greater increases in purity from mixed juice to syrup, 3 the same, and 11 less increase than they reported in 1922. No factory reported a drop in purity from mixed juice to syrup in either 1922 or 1923. During previous seasons such drops have been reported. The tendency to use a larger amount of lime during the last two years continued this season. The increase has been from 0·084 per cent. in 1922 to 0·087 per cent. on cane in 1923. The average increase in purity from mixed juice to syrup was 1·53 in 1923, against 1·29 in 1922. The press work in 1923 was not so good as during the season before; 2·29 polarization of the press cake is the average figure for 1923 against 2·07 in 1922. Slightly less mud was handled in 1923; the figure for 1923 was 2·46 on cane and in 1922 it was 2·51. During 1923, 63·26 Brix of syrup was the average obtained. As the Brix of the mixed juice was 13·13, this indicates 19·24 per cent. evaporation, the highest average yet recorded.

A rather high polarization of the commercial sugar is maintained in Hawaii; the average for the crop was 96·90 in 1923 and 96·88 in 1922. The moisture content in the sugar has been reduced from 0·87 in 1922 to 0·83 in 1923.

The low-grade work during 1923 was much better than during 1922. In fact a new record was established in the gravity purity of the final molasses, the average for the season being 37·90. This is 0·85 lower than in 1922, and 0·05 lower than the previous low point, which was reached in 1919. One factory reports an average for the 1923 season of 33·16 gravity purity; this is also a new record, the best average reported before for any one factory being 33·95.

The undetermined losses have also been materially reduced, averaging for the season 0·48 polarization per 100 polarization of cane. In 1922 the average undetermined loss was 1·27.

Two factories in Hawaii used the Petree & Dorr process during the 1923 season, which is the first year that this process has been tried out in Hawaii. These two factories produced 12 per cent. of the crop. Comparison of the 1922 and 1923 total crop results is therefore not quite fair, especially where the mixed juice figures are used in the calculations. Factories using the Petree & Dorr process have to report clarified juice and use those figures instead of the mixed juice in their calculations. It is interesting to compare the results from one of these two factories for the 1922 season without the Petree & Dorr process, with the 1923 season when the process was used :—

	Extraction	Purity 1st. Mill.	Over-all Recovery.
1923 with Petree & Dorr Process	96·98	89·28	91·78
1922 without Petree & Dorr Process	98·19	88·55	88·57

We find that this factory with 1·21 per cent. less extraction but with slightly higher juice purity (0.73) obtained 3·21 higher over-all recovery in 1923 with the PETREE & DORR process than during 1922, when operating without the process. The drop in purity from first expressed juice to syrup was for this factory 2·23 in 1922, and 1·63 in 1923.

Evaporation under Pressure in the Beet Sugar Factory.

In a series of articles on this subject, Prof. ALES LINSBAUER, of the Brunn Station of the Czecho-Slovakian Experiment Station, recently set forth[1] in considerable detail the steam requirements of beet sugar factories as operated under European conditions, these dealing not only with the vacuum system hitherto universally employed, but also with so-called pressure evaporation,[2] which has come into use in several factories in Bohemia, and promises to be adopted in others.

These data are based on a series of trials carried out under full operating conditions in different factories for the purpose of establishing the comparative value of the two systems, this being, as Prof. LINSBAUER remarks, a matter of practical proof rather than of theoretical calculation.

As a result of these experiments, the number of kg. of steam per 100 of roots is stated for the two systems, these being for the conditions prevailing during the 1921-22 and 1922-23 campaigns. At the same time the proportion of these values necessary only for the evaporation of water is also given.

Before summarizing these data, it is preliminarily observed in regard to the present system of vacuum evaporation that combined quadruples are most widely used (in Czecho-Slovakia anyway), and combined quintuples less so, while simple quintuples and sextuples are only exceptionally installed. Pre-boilers are little employed in the country mentioned. Nevertheless, the author has taken into consideration the system having a pre-boiler before a combined quadruple, in order to show its advantage in comparison with combined quadruples and quintuples without this apparatus. It is emphasized that the steam economy of a sugar factory is not decided by the evaporating plant proper, but largely by the conditions prevailing at the heating and boiling stations.

Referring to Table I, the results of the author's many experiments for several vacuum and one pressure systems are summarized, these being for juice draw-offs of 115 and 105 per cent.

In addition to the relative efficiency of evaporators, this study demonstrates that the factories equipped with a simple vacuum system evaporator obtain results which are better the denser are the diffusion juices they concentrate.

Turning now to the second part of the series, the various arrangements for evaporation under pressure are discussed, one of the calculations showing the steam requirements of a plant for evaporation of juice to densities 60° and 70°Bg. with draw-offs of 115 and 105 per cent., the figures relating to these being summarized in Table II.

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[1] *Zeitsch. Zuckerind. Czecho-Slov.*, 1924, 48, 165–171, 173–178, 187–189, 195–201, 203-207.

[2] *I.S.J.*, 1924, 332.

Table I.

No.	Evaporating System.	Syrup Density, degrees Balling.	Juice Draw-off, 115 per cent.				Juice Draw-off, 105 per cent.			
			Total Steam Consumption, in kg. per 100 of Roots.	Coal Consumption per 100 of Roots (1 kg. coal = 8 of water).	Steam Consumption for Evaporation proper, in kg.	Water Evaporated in kg., with 1 kg. of Steam.	Total Steam Consumption, in kg. per 100 of Roots	Coal Consumption per 100 of Roots (1 kg. coal = 8 of water.)	Steam Consumption for Evaporation proper, in kg.	Water Evaporated in kg., with 1 kg of Steam.
1	Simple sextuple, under vacuum	60	65·1	8·13	15·3	6·0	59·5	7·43	13·6	6·0
2	Simple quintuple, under vacuum, with preheater	60	62·6	7·82	12·8	7·2	57·4	7·17	11·5	7·2
3	Simple sextuple, under vacuum	70	60·1	7·51	16·1	6·0	55·4	6·92	14·5	6·0
4	Simple quintuple, under vacuum, with preheater	70	57·7	7·21	13·7	7·0	53·2	6·65	12·3	7·0
5	Combined quadruple, under vacuum	60	56·5	7·06	6·7	13·8	51·9	6·48	6·0	13·8
6	Combined quadruple, under vacuum, with pre-boiler	60	55·5	6·93	2·9	31·7	51·5	6·43	3·1	26·1
7	Combined quintuple, under vacuum	60	54·0	6·75	4·2	22·0	49·6	6·20	3·7	22·4
8	Triple, under pressure	60	49·2	6·15	gratis	—	45·1	5·63	gratis	—

Table II.

Syrup, degrees Bg.	Steam Consumption in kg. per 100 of roots. Draw-off, 115%.	Steam Consumption in kg. per 100 of roots. Draw-off, 105%.	Coal Consumption per 100 of roots (1 coal = 8 water). Draw-off, 115%.	Coal Consumption per 100 of roots (1 coal = 8 water). Draw-off, 105%.
60	49·2	45·1	6·15	5·63
70	43·7	40·4	5·46	5·05
Economy	5·5	4·7	0·69	0·58

It is therefore seen that it is more economical when using evaporation under pressure to produce syrup at 70°Bg. than at 60°., and this is so whether the apparatus be a double or a triple effect. Actual experiments made with double effects under pressure were found to require 41·0 kg. of steam when evaporating to 70° Bg. with a draw-off of 105 per cent., in comparison with a theoretical value of 40·4°. Also, it is pointed out that pressure evaporation eliminates the water from the thin-juice without cost (in theory), as is stated in Table I, and that therefore further economy can only be realized at the heating and boiling stations.

Calculations are stated showing that when using pressure evaporation the steam consumption in double and triple effect is practically the same, but that the double effect system is the better adapted to the uses of the "mixed factory," that is the factory-refinery, producing both raw and refined, whereas the triple is more suited to the factory making raws. In operating the triple under pressure, vapour for the vacuum pans should be taken from the third body, and only in case of urgent necessity from the second. To take it from the first is uneconomical, a point of difference compared with the ordinary vacuum system.

Besides Prof. Linsbauer's articles, a number of other contributions on the subject have appeared in the sugar technical press of late, and four of these will briefly be summarized.

Ed. Gogela[1] traces this development historically, mentioning that up to the present time the system has been installed in four Bohemian, three Moravian, and two Austrian factories, and in one Hungarian and one German factory, while several new plants in Italy under erection are being equipped with evaporators operating in this way.

C. Tschaskalik[2] gives an account of some of the difficulties experienced in the early operation of pressure evaporation. It was feared that the high temperature would cause sucrose decomposition and juice discoloration, but such apprehensions were found to be groundless in practice. Then, as the result of the high temperature used, the heating surfaces were heavily incrusted with matter thrown out of solution, but this was overcome by preliminarily heating the juice to as high a degree as possible, the heating surfaces at the start being also very thoroughly cleaned. Under these conditions, to maintain the original rate of evaporation, only a small increase in the pressure of the exhaust, viz., 1¼ lbs., was necessary. Another irregularity which was anticipated was that it would be difficult to maintain regular pressures and temperatures in the several bodies in the absence of the condenser and air-pump, especially after variations in the juice supply. As a matter of fact, experience proved that this pressure system can be operated with greater regularity than when working under vacuum[3] by the use of a steam regulating valve, which, when the pressure in the system increases, cuts down the steam supply, the excess of pressure being taken care of by the juice-heaters.

An American writer (anonymous)[4] discusses the subject from the point of view of conditions in the United States, mentioning that in his country there is opportunity for a much greater reduction in the coal consumption than in Central Europe. In one of the most modern, best equipped, and most efficiently managed beet factories in the United States, the steam consumption is 64·9 lbs. per 100 of roots, while in another under the same management, though not so modern, it is 71·9; whereas with pressure evaporation 50 may be taken as the average figure, and 55 as the result of vacuum evaporation under the best conditions. The high steam consumption in American beet factories is of course mainly due to the greater dilution of the diffusion juice, the draw-off being 130–150 per cent., as compared with 105–115 per cent. in Europe. Although in the United States the cost of fuel is considerably less, yet an examination of pressure evaporation from the standpoint of American conditions is desirable. Another point which should be considered is the reason for a draw-off as high as 150 per cent. when Europe appears to operate well with one of 105 per cent. only.

Lastly, there was published recently an article by a German writer, Ivar Fogelberg,[5] who is opposed to pressure evaporation, and his views are certainly of interest in considering the question. In sugar factories in Germany employing sextuple vacuum evaporators, 42 kg. of steam are required for evaporating 100 of water, 0·3 kg. going to the condenser; while in factories in Bohemia using a quintuple the same amount of steam is demanded, 0·8 kg. going to the condensers. On the other hand, pressure evaporators require 33·3 kg., but then the vapour produced is insufficient for juice-heating, etc., thus necessitating steam being taken from the boilers, so that in the end the steam consumption is about the same, viz., 42 kg. Therefore, according to this writer, the question of abandoning vacuum in favour of pressure operation should be very carefully considered.

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[1] *Centr. Zuckerind.*, 1924, **32**, 389–390.
[2] *Ibid.*, 1924, **32**, 507–510.
[3] See *I.S.J.*, 1924, 3.
[4] *Facts about Sugar*, 1924, **18**, No. 18, 416.
[5] *Centr. Zuckerind.*, 1924, **32**, 510.

Recent Work in Cane Agriculture.

ANNUAL REPORT OF THE INSULAR EXPERIMENT STATION, PORTO RICO. *1922-23.* The usual table is drawn up of the staff, together with the periods of service during the year; this shows that this problem continues, and indeed is the main one to be solved by the department. The losses are more than usually serious, and include the Chief of the division of Plant Pathology and Botany (**MATZ**), the Expert in Cane Diseases (**CHARBON**), and the chief chemist (**GORBEA**), while the chief entomologist was absent during the year on account of sickness. A certain alleviation was granted in that some of the salaries were slightly raised. **MELVILLE T. COOK** succeeded **MATZ**, but no one followed **CHARBON**. The station budget appears to be short in the matter of travelling allowances, which is a somewhat serious handicap, but the item for maintenance of buildings ($60) is wholly inadequate. As the Director reports, "only two buildings could be painted during the year, although several are badly in need of paint"; this seems to be a rather anomalous state of things when we consider the rapid depreciation of construction work in the tropics. In considering these matters, it must be remembered that the sugar industry is by far the most important in the island. This is evidenced by the allotments at the Insular Experiment Station, which is supposed to cover all the crop investigations; five-sixth of the money is spent on sugar cane experiments, while of the 101·89 acres of land sugar cane occupies 40 and pasture 37·15.

In the director's report interesting details are given concerning varieties being tested on the station. BH 10–12 and Saint Croix 12/4 head the list, both giving heavy tonnage and high yields of sugar when harvested as *primaveras*, and both are resistant to drought and more than is usual to mosaic. SC 12/4, however, failed completely when tested against gumming, but BH 10–12 proved resistant. In the districts, SC 12/4 was severely attacked by borers and again BH 10–12 suffered little; so that this latter cane can with more confidence be recommended for general planting. Uba appears to have poor juice when planted as *primaveras*, but succeeds better in *gran cultura*, so that serious attention is being paid to a search for early maturing cane varieties. L 511 grew very well and upheld its reputation as a "very precocious high sucrose yielder," in one instance showing 17 per cent. sucrose when nine months old. D 74 and Badila have been successfully established and are being propagated for distribution. D 216 also appears to be very promising, with wonderful vigour and quick growth, but no sucrose test has been possible yet. On the west coast PR 440, a purple cane of great vigour and precocious maturity, appears to be best adapted of those being grown there in the experimental plots.

Some space is devoted to the consideration of the Uba cane. The director states that it has "found its worth by its absolute immunity to mosaic and gumming, and its wonderful vigour and ability to ratoon well even in the red clay hills." Its sucrose content, however, varies very greatly with soil and climatic conditions, resulting in most conflicting opinions as to its value in the island. **EARLE** is quoted as failing to duplicate the sucrose content, with variations all the way from 18·28 per cent. to 10 per cent. in the crusher juice. Good tonnages have been obtained as *plantillas* and ratoons, over 90 tons to the acre having been reported from several localities. In Central Eureka it has proved a great success, the 1922-23 crop being double that of the local kinds (because of disease); the canes were taken well at the mills, and the heavy fibre content made it unnecessary to buy supplemental fuel. The average *rendément* of commercial sugar on cane was 9·40 per cent. as against 10·50 per cent. in the other canes, but this of course was a matter of little moment when the yields were doubled. Uba has proved of immense value on the western coast, just as D 433 has round Central Fajardo in the east. This hardy cane has "come to stay"; and its variations have been of use in wakening up the farmers to appreciate the importance of selecting their cane varieties. A reference is here made to the great variations in soil and climate met with in Porto Rico sugar estates, as in the semi-arid alluvia of the south coast, the flood plains of the well-watered northern coast, the eastern coast round Fajardo and Yabucoa, the inner lowlands of the Caguas valley, the limestone lowlands round Isabella, and clayey alluvial swamps on part of the western coast.

The reports of the Chiefs of the Pathological and Entomological sections are very short and contain less matter of interest than usual, for reasons already explained. In the former the assistant writing the report complains of much interruption of the work because of changes in the personnel, and the absence of notes left in the files of those resigning. In Entomology the chief assistant was absent through illness. Experiments were made in the use of potassium cyanide and paradichlorobenzene, for the extermination of white grub, treating *Lachnosterna portoricensis*, the largest form, which occupies two thirds of the island to the east. It was found that potassium cyanide was only half as effective when used as crystals as when dissolved; paradichlorobenzene is usually given as crystals, but the mother liquor supplied by the Hooker Chemical Company was found to be equally destructive. The latter poison was given in various amounts from 0·1 to 0·3 oz. per cub. ft. (the latter being 800 lbs. per acre); the larger quantity was found to be necessary to destroy all the grubs in the ground, but its cost was considered to be prohibitive. Interesting observations were made on a beetle enemy of the white grub, namely *Pyrophorus luminosus*; larvae were reared, and in one case a single specimen accounted for 68 white grubs. Transmission of mosaic by *Aphis maidis* was confirmed by direct experiment, the infection appearing some time after the introduction of the insect to the canes; in fact it is stated to have been first noted as the last aphis died. Experiments as to the transmission of gumming disease suggested rats as the vectors in the case under investigation.

THE STATUS OF PLANT PATHOLOGY IN PORTO RICO. *Melville T. Cooke, Chief of the Division of Plant Pathology in Porto Rico. Journal of the Department of Agriculture of Porto Rico. Vol. VII, No. 3, July, 1923.*

This paper is chiefly historical and bibliographical and shows very well both how very recent the study of plant diseases is in Porto Rico, and what a large number of papers have appeared in it since the island passed into the possession of the United States in 1898. The study of plant pathology is inseparably connected with that of the fungus flora, many of which may be comparatively harmless, and a good many of the papers referred to are in consequence lists of the fungi collected. The great masses of vegetation in this tropical island and the differences in soils, and especially of crops and climate, have shown their effect in producing a great wealth of fungus forms. The temperature and rainfall distribution are carefully summarized and are illustrated by interesting maps obtained from the U.S. Weather Bureau Office in San Juan, and there is also much information as to the physical character of the island.

INSECTAE PORTORICENSIS. A PRELIMINARY ANNOTATED CHECK LIST OF THE INSECTS OF PORTO RICO, WITH DESCRIPTIONS OF SOME NEW SPECIES. *G. N. Wolcott. Ibid. Vol. VII, No. 1, January, 1923.*

This volume of over 300 pages summarizes the work done on the Entomology of Porto Rico up to date, and contains an immense amount of information, which will serve as a useful work of reference for all engaged in tracking down the insect enemies of the crops of the island. In the bibliography at the commencement "only the general papers, and the economic papers dealing with insects of several orders are given; the larger systematic and descriptive papers are given in the body of the list (of insects) under the orders; and the shorter papers dealing with one or two insects are given under the insect." The paper is most comprehensive but, after a reference to a recorded collection made in 1797 and published in 1816, the author passes to work commencing in 1882, and gives voluminous details of all papers published since that date, with a statement of the signs used in the list, indicating the character of the references. Altogether the paper forms a most valuable record and must have taken a world of labour, which will be fully appreciated by subsequent workers in this important field.

Annual Report of the Bureau of Sugar Experiment Stations, Queensland. *H. T. Easterby. For the year ending October 31st, 1923.*

As is usual, this Report begins and ends with a brief statement of the economic position of the cane sugar industry in Queensland. The Government declined to continue the last agreement which had done so much to put the industry on its legs, and decided to withdraw its control, although this inevitably remains in a modified form, in that it is stipulated that the price of the sugar produced shall not exceed £27 per ton for the next two years, in place of the £30 odd paid for it during the past three years.

The climatic conditions were again very unsatisfactory over the greater part of the area, but at the time of writing it was estimated that the crop would reach 260,000 tons of sugar, a drop of 26,000 from the one obtained in the previous year. In this calculation it was assumed that one ton of sugar would be produced from 7·5 tons of cane, as the commercial cane sugar in the canes has been good during the season; adding 18,000 tons for New South Wales and 2800 tons from beet in Victoria, this gave an estimated yield for the Commonwealth of 280,800 tons of sugar for the season. Prospects were not good at the time of writing for the succeeding year's crop. The rainfall of the year was low, but the consequent poor crop in the south was compensated by splendid yields above Townsville; here, in spite of its being one of the driest years experienced, the crops were exceptionally good and the commercial cane sugar high. In other words, it appears that while the rainfall in the south is generally on the low side for sugar cane growth, it is somewhat excessive in the north. Turning to the experiments, these are perhaps less interesting than usual, as many of them have passed to the second and even third ratoon stage, and are practically completed, in almost all cases bearing out the results obtained during the previous periods of trial. It is to be remembered that such continued growth of the same plants is not likely often to reverse the results at first obtained, in that, when once a better stand is observed in the plant canes this is, other things being equal, likely to continue however long the experiment lasts. In this sense the results obtained year by year are not so confirmatory as would at first sight appear.

South Johnstone Experiment Station.—The third ratoon *manurial plots* showed what is thought to be a remarkably high yield, but the no manure plots in every case gave a greater tonnage of canes than those manured. This is taken to indicate that the separate types of manure given are likely to be of less use than a complete mixed fertilizer which was not included in the series. *Subsoiling* carried on to second ratoons again proved beneficial, the greater yield more than compensating the cost of the operation. The increase in yield on all the subsoiled plots averaged, when put together for the three years, as much as 10 tons of cane per acre. The *application of lime* does not appear to show any advantage. In the *analysis of varieties* on September 13th (13 months old) the canes appear to have been unripe, whereas in the same varieties harvested as second ratoons (13½ months old), the sucrose and purity were very high. *Pests and diseases* continued to be studied and fought against. Control measures over rats appear to have reduced their ravages over the South Johnstone area. The borer is very widespread throughout the district and appears to be increasing; it is being combatted by the liberation of the tachinid fly parasite. Linear bug is still abundant throughout, but it does not appear to be multiplying and is apparently being kept in check by its natural enemies. No serious disease was reported during the year, but it has been noted that the improvement in the Badila crops grown from tableland seed is not being maintained.

Mackay Experiment Station.—The weather during the growing period was highly unsatisfactory; the amount of rain falling was 20 in. less than in 1921-22 and 46 in. lower than in 1920-21. To illustrate the vagaries of the climate in this respect, the total rainfalls during the five preceding years (1918-22) were 113·97, 38·03, 57·27, 95·89, and 34·47 in. respectively, while during the first ten months of 1923 only 21·84 in. were recorded. Besides this dry weather, the winter was severe and some of the canes were damaged by frost. In these circumstances the experimental work on the farm was conducted under great difficulties. The plots of *varieties from different countries* (Demerara, Barbados, Fiji and Queensland) were carried on to second ratoons, and the results are given in detail. In spite of low yields in this last season the average for crops was very fair, 7 R 428, Q 813 and Q 1121 giving the best results. Experiments with *potassium chloride as a manure* in comparison with potassium sulphate, in the second ratoon crop, agreed with previous results in showing no deleterious effects on the juice. This is shown by the average sucrose and purity for the three years, for KCl, K_2SO_4 and no potash respectively, as follows: 15·41 and 93·4, 15·37 and 93·5, 15·44 and 93·8. The *competitive trial* among certain selected cane varieties was continued to first ratoons; these were Q 813, NG 24 B, Shahjahanpur, HQ 77, M 168^{01}, EK 28, 2 and 1, Java 247 and 100 Bont, H 109, 146 and 227. From a tonnage point of view the leading canes were Q 813, EK 2 and EK 28, and as regards average yield of sugar per acre Q 813, EK 28. *Spacing experiments* started in the previous year in two series, one with different distances between the plants in the row and the other with rows at different distances apart bore out the wisdom of the usual close planting.

Bundaberg experiment station.—In the second ratoon crop *liming* gave practically no increase, either when pulverised limestone or burnt lime was used. Similarly, large amounts of lime (1-6 tons per acre) produced little result, and on the red soils of the station it is obvious that liming in any form is not a paying proposition. Experiments were conducted as to the best *source of planting material*, whether plant cane, 1st, 2nd or 3rd ratoons. This experiment, now continued to 2nd ratoons, showed that 3rd ratoons may produce very good seed for planting. *Subsoiling* experiments continued to 2nd ratoons gave an average decrease of 3·02 tons of cane per acre for each crop; doubtless this is owing to the permeable nature of the red soils of the station. The results of experiments in using *different parts of the cane for seed* purposes, using three-eyed sets from top to bottom, carried on for three years, seem to show that any part that is fully matured will serve this purpose; the highest yields were obtained from sets next to the top set and from the bottom sets of the series. This result was rather to be expected in such a dry tract, as the immature tops would stand a good chance of being dried out before germination could take place. Experiments with *potassium chloride* as a source of potash gave results altogether similar to those at Mackay, incidentally demonstrating the usefulness of potash for the red open soils at Bundaberg; this result was confirmed by the succeeding *manurial trials*. *Spacing experiments* were continued to first ratoons, and, as at Mackay, close planting gave the greatest yield of canes and sugar. It was also noted that distance in the row was of less importance in this matter than the spaces between the rows. No definite results were obtainable with *different kinds of planting* because of the great drought. The *competitive trials* between new canes led to the discarding of several varieties; H 109 appeared to be developing "top-rot," and was discarded, J 247 and Java 100 Bont ratooned so very poorly that they were not gone on with, while Shajahanpur No. 10 developed Mosaic and was ploughed out. This left the following:—EK 1, 2 and 28, Hawaii 146 and 227, Mauritius 168^{04}, D 1135 and HQ 77. The plant crop was from standovers, and this was now ratooned; a factor was thus introduced of getting a good stand of ratoons from standovers, and thus far EK 1 was best, with EK 2 second, and D 1135 third. In a *further competitive trial* of canes from different countries, now carried on to first ratoons, M 28/10 gave the best tonnage and 7R 428 (Fiji) came second.

The average tonnage of canes grown on the three stations during the year was, for South Johnstone 34·06, Mackay 13·1, and Bundaberg 8·28, figures which tell their own tale. Seedling work was continued at South Johnstone but, generally, although seven varieties are reported to have flowered, the germination was very unsatisfactory, the best being from arrows of Q 903. Three varieties were reported to have flowered at Mackay, but none were mentioned for Bundaberg, the dry weather being presumably responsible for this lack of flowering all through.

C. A. B.

Barbados.

The Sugar and Molasses Crop of 1922.[1]

According to the Customs Returns of Barbados the exported sugar and molasses crops of 1922 were 29,876·5 tons of vacuum pan crystals, 3,946·1 tons of muscovado sugar and 7,390,409 wine gallons of molasses, equal at 110 gallons per puncheon to 67,186 puncheons of molasses of all grades, of the total value of £899,658, made up as follows:—

	Tons		Valued at £
White crystal sugar	0·70	....	14
Yellow ,, ,, ...	12 00	....	192
Dark ,, ,, ...	29,863·55	....	447,947
Muscovado ,, ...	3,946·10	....	55,245
	33,822·35		£503,398
	Gallons.		
Fancy molasses	6,555,749	....	382,419
Choice ,, ...	823,521	....	13,725
Vacuum pan molasses	11,139	....	116
	7,390,409		£899,658

Fancy molasses is concentrated cane juice from which most of the impurities have been removed, but owing to the impossibility in the ordinary muscovado sugar factories of concentrating each tayche or panful of fancy molasses to the same density it is difficult to say how many gallons of this molasses are equivalent to a ton of muscovado sugar. However, from data obtained from various sources it would appear that 380 wine gallons of fancy molasses at 41° Beaumé are equivalent to one ton (2240 lbs.) of centrifugal muscovado sugar and 115 wine gallons of choice molasses. At this rate, the fancy molasses manufactured in 1922 is equivalent to 17,252 tons of sugar. The total sugar crop, therefore, if no fancy molasses had been made, would have been 51,074 tons, i.e., 15,069 tons more than the previous year. The above does not include the sugar consumed in the island, which is estimated to be about 8000 tons.

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[1] Department of Agriculture Report.

Publications Received.

Tables de Concordances et Tables Diverses. Compiled by E. Haddon. (General Printing & Stationery Co., Ltd., Mauritius) 1923.

Mr. HADDON has re-calculated the data on which the "tables de concordances" which have been used in Mauritius since 1916 have been based, and his figures now show a more exact relationship between the densities at 20°C.; Baumé degrees; and Vivien degrees (grms. of sugar per 100 c.c.). In addition the book contains tables showing densities at 20°C. and Brix and Baumé degrees; tables for use in polarimetric analyses (using 16·29 and 26·00 grms. as normal weights) and tables for use in the determination of reducing sugars. Lastly, some useful formulæ for use in chemical control are appended.

La Culture de la Betterave à Sucre. E. Gaspart. (Librairies Lambert de Roison, rue de l'Ange, Namur, Belgium). 1914. Price: 5 francs.

Contents: Economic considerations; cultural principles; natural conditions; cultural conditions; position in rotation; labour; manuring; seed; planting; matters relating to contracts; diseases and pests; harvesting; sale of the roots; by-products of beet cultivation and of sugar manufacture.

The Micro-Organisms of the Soil. By Sir Edward J. Russell, F.R.S.; and Members of the Biological Staff of the Rothamsted Experimental Station. (Longmans, Green & Co., London). 1923. Price: 7s. 6d.

Contents: Development of the idea of a soil population; occurrence of bacteria in soil; conditions affecting bacterial activities in the soil; protozoa of the soil; soil algæ; soil fungi; invertebrate fauna of the soil; chemical activities of the soil population; and their relation to the growing plant.

Regulations under the Food and Drugs Act (of **Canada**). Made by Order in Council. (Department of Health, Ottawa, Canada). 1924.

Contains regulations and specifications relating to food-stuffs in respect of the standard of purity with which such goods must comply for sale in Canada. Sugar, syrup, and related products, and rum are included.

Mr. NORMAN RODGER has in the press and hopes to publish about the end of October a second and revised edition of Dr. H. C. Prinsen Geerligs' standard work, "Cane Sugar and its Manufacture." The first edition has been out of print for some two years past; but owing to repeated requests for copies on the part of the sugar world generally, not to mention the several sugar educational establishments that use it as their text-book, the author has lately been induced to revise his work. Whereas the first edition related chiefly to Java practice, the new one will include mention of other world practice that has become standard, and will therefore be more comprehensive. The first part of the volume relating to the theoretic side is naturally not capable of much revision, but the second part relating to the practice of manufacture has been brought up to date and nearly a third of it is new valuable matter. The price of the new volume will be 21s. post free.

Brevities.

A centrifugal pump suitable for withdrawing thick-juice at a density of 1·300 and a comparatively high temperature from the last vessel of the evaporator under a vacuum of 60-65 cm. is described by J. FREY.[1]

The total production of sugar on the island of Réunion during the 1923-24 season amounted to 42,872 tons, with an average extraction of 8·92 per cent. of sugar from a total of 480,103 tons of cane crushed. There were 16 mills in operation.

It is claimed by ED. VRANCKEN[2] that the Deguide barium saccharate process[3] is superior in respect of efficiency and economy to any form of the Steffen process, or to any other method of desaccharifying molasses, as it solves the problem of the regeneration of the barium carbonate.

Machines for slaking lime were recently described[4] and their advantages demonstrated over the customary method. An easily-flowing milk of definite composition, free from grit, lumps, and unslaked material, can thus be obtained, while the operation of the apparatus is practically automatic.

Dr. JAR. DEDEK recently described[5] a grade of cloth for use in the presses separating the carbonatation scums in beet factories, in the use of which the rate of filtration does not fall off, compared with that initially observed. Moreover, it enables the precipitate to be washed down further than with ordinary filter-cloth.

According to a writer in the *Financial Times*, the name "Mincing Lane," the well known centre of London's sugar trade, is derived from the convent of the *Mincheons* or nuns who at one time owned property in this ancient lane; and has nothing to do with mincing or mincemeat, as has been humorously suggested.

A booklet collating the recent literature on the question of sugar dust explosions, and the measures to be adopted in avoiding them, was recently published by two German writers[6] They deal with the problem both from the theoretical and the practical points of view, and give a number of good illustrations of sugar grinding plant The theories of one of these authors were recently described in this Journal.[7]

In the Benson 3200-lb. pressure steam generator, or coil "boiler,"[8] water is converted into steam at its critical temperature, viz., 706°F. (375°C.), this change taking place without alteration in volume, and quietly without boiling or any show of explosive violence Furthermore, no latent heat is required to effect the change of state, no work having to be done to bring about an increase in volume. This elimination of latent heat does not in itself result in any higher efficiency in the condensing turbine, the heat being lost in the condenser just the same. That is to say, the increase in the theoretical efficiency to be obtained by using steam at 3200 lbs. pressure, as compared with say 2750 lbs., is very small. The practical difference, however, is enormous, because in the first place no latent heat of steam is required and a coil generator can be used, whereas in the second case the latent heat of steam is about 290 B. Th. U. (from 1 lb. of water at 32°F.), and some sort or other of boiler is required. A great economy of fuel is theoretically possible by working at 850°F. and 1500 lbs.; and in the Benson method of working in this way it is claimed steam can be generated from coal at an efficiency of 28 to 30 per cent., as compared with 17 to 18 per cent. for the most modern superpower station at 700°F. superheat and 350 lbs. pressure. In a Benson installation which is operating at Rugby, England, water is converted in a coil to vapour having a temperature of 706° F. and a pressure of 3200 lbs.; it is then superheated to 720° F., passed through a reducing valve (its temperature falling to 620° F.), again superheated, and finally discharged at 850° F. and 1500 lbs. pressure This steam is being used at Rugby to drive a high-pressure turbine exhausting at 200 lbs. pressure into an ordinary condensing turbine, the exhaust from which (at about 40 lbs. pressure) will be available for various heating purposes.

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[1] *Zeitsch. Zuckerind. Czecho-slov.*, 1924, **48**, 268-269. [2] *Sucrerie Belge*, 1924, **44**, 2-18, [3] *I.S.J.*, 1923, 51 [4] *Chemistry and Industry*, 1924, **43**, 481-482.

[5] *Zeitsch. Zuckerind. Czech-slov.*, 1923, **47**, 346.

[6] P. BEYERSDORFER and W. H. GECK. (H. FISHER, Worms). [7] *I.S.J.*, 1923, 412-415.

[8] *Chemistry and Industry*, 1924, **43**, 249-250, 781-782.

Review of Current Technical Literature.[1]

"SUPER-DEFECATION" OF CANE JUICE, USING HORNE'S PROCESS. *W. D. Horne.* *Facts about Sugar, 1924, 18, No. 21, 492-493.*

Horne's process of so-called "super-defecation," which claims to obtain the complete precipitation of impurities without the disadvantages of excessive liming, has already been described.[2] In the present article some particulars are given of its application in a Cuban mill during the last week of a campaign. Juice much cleaner than ever before, showing 1° higher purity, was obtained, and the evaporator syrup was clear and deposited no sediment, while a good direct consumption sugar at 99° with a second sugar at 96° were obtained. Analysis made of the juice and syrup indicated a removal of over 39 per cent. of the ash, no inversion of sucrose, and no increased destruction of reducing sugars. On the other hand, the slightly greater alkalinity of the defecation had as its result a more abundant precipitate, which increased the filter-press mud by about 13 per cent. Settling was a trifle slower, due to the greater alkalinity, but the second precipitation took place very quickly, requiring about 60 per cent. as much settling capacity as the ordinary defecation system. In regard to the molasses, the ash in this fell from 11·53 per cent. at the beginning of the trial to 6 26 per cent. at the end of the run, while its volume decreased from 7·76 gall. per bag of sugar to 6·55 gall. But one of the most gratifying results was the reduction of the ash of the 96° sugar, which averaged 0 30 per cent., that is only one-half of the average for Cuban centrifugals during the past 20 years. Thus, from such a sugar the refiner should obtain a better yield, especially as it was light in colour, freer from "gumminess," and had a nucleus so pure that it could be washed up to 99·5° as easily as an ordinary sugar can be washed up to 99°. It is estimated that the cost of equipping the process is about 60 per cent. more than in ordinary defecation, this being due principally to the increased apparatus for settling, and the pumps for moving the solutions, the cost of the chemicals being about 2·3 per cent. per ton of dilute juice handled, from which about 1·3 per cent. can be deducted from the manurial value of the press-cake from the second precipitation. This increased cost, however, should be repaid several times over by the better yield of raw sugar as the result of the increased purity of the juice, not to mention the greater facility of operating on material free of suspended matter and liberated of much of its "gumminess."

NEW FORMULA FOR MILL WORK CONTROL, THE RESIDUAL RATIO OF THE BAGASSE. *R. F. H. Schmidt.* *Archief, 1923, 31, No. 39, 1045-1048.* (*B*) *N. Nobel.* *Ibid., 1924, 31, No. 39, 1048-1049.*

(*A*) In "Contributions from the Experiment Station" (Java) No. 6 of 1923,[3] it is mentioned that the *SPQ* (juice extraction quotient) falls too close to 100, and is therefore not a convincing datum; but that if the residual ratio in the bagasse from the last and from the first mills be introduced, then more comparable and more striking figures running far below and above 100 are obtained. A residual ratio greater than 100 denotes an extraction inferior to that of Bolk's normal table, and one less than 100 a superior one. According to the method of calculation recently given,[4] the residual ratio is :—

$$R = 100 \times \frac{\text{Juice water in bagasse per cent. fibre.}}{\text{Juice water in cane per cent. fibre} - \text{normally expressible water per cent. fibre} = N}$$

while the juice extraction quotient is :—

$$SPQ = 100 \times \frac{\text{Juice water in cane per cent. fibre} - \text{juice water in bagasse per cent. fibre}}{N}$$

In this first article, it is shown that the residual ratio is not an independent value, since it has a constant relationship to the *SPQ*, and that it cannot give a more comparable figure than the *SPQ*. (*B*) In this second article, the writer points out that the purpose of these formulae is simply to compare the mill work in different installations with different kinds of cane, and that the two formulae are of value since relationship between them varies with these two factors, viz., the mill operated and the cane ground. But the residual ratio shows a greater proportional variation than the *SPQ* even with slight numerical variations, and in consequence is a more useful formulae for mill work control.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] U.S. Patent, 1,486,091.

[3] *Mededeelingen van het Proefstation,* 1923, No. 6.

[4] *Archief,* 1923, 70.

FUEL USED IN DEFECATION, SULPHITATION, AND CARBONATATION FACTORIES IN JAVA.

Ph. van Harreveld. Archief, 1923, 31, No. 51, 1416-1417.

Some 128 factories in Java took part in the "fuel control" scheme instituted by the Experiment Station; and from the data collected it appears that during the nine periods into which the campaign was divided the number of calories per kg. of cane necessary as extra fuel amounted to the following :—

PERIOD.	1	2	3	4	5	6	7	8	9
Defecation	72	73	79	76	52	39	41	18	5
Sulphitation	108	99	93	125	74	88	50	69	95
Carbonatation	63	65	115	76	38	30	13	4	26

While the total number of calories used per kg. of cane during the same periods is stated as :—

PERIOD.	1	2	3	4	5	6	7	8	9
Defecation	633	612	613	617	618	613	631	608	601
Sulphitation	690	644	634	662	636	659	635	653	669
Carbonatation	610	620	646	619	592	587	585	586	599

ACTION OF LIME ON THE NON-SUGARS PRECIPITATED IN THE DEFECATION OF BEET JUICE.

Vladimir Stanek. Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, No. 38, 301-307.

Beet diffusion juice at 65°C. was treated with sufficient milk-of-lime to give a readily subsiding precipitate, which was separated by centrifuging, and washed with lime-water until sucrose-free. A weighed portion of this precipitate was extracted with milk-of-lime at 85°C. during 20 min. while continually stirring, then filtered off, and washed. It was then re-extracted, this time with milk-of-lime at water-bath temperature during four hours. Examination of these extracts showed that in neither case was more than a small portion of the precipitate dissolved. Following this, the influence of carbonatation under the conditions obtaining in practice was studied, when it was observed that approximately half the non-sugars present were precipitated and eliminated in the carbonatation scums. Another point examined was the extent to which the purity of the carbonated juice may be lowered by the solution of non-sugars, and this was found to be not more than 0·2°, which demonstrates that the removal of the lime precipitate in the carbonatation process previous to passing in the CO_2 (as has been frequently recommended) does not offer the advantages claimed, at least so far as any effect on the purity is concerned.

CAN FLASKS CALIBRATED AT 15° C. BE USED AT 20° C. FOR THE POLARIZATION OF SUGAR PRODUCTS?

G. Bruhns. Centralblatt für die Zuckerindustrie, 1924, 32, 51.

It is very frequently thought that flasks calibrated at 15° C. cannot be used for higher temperatures, as 20° and 28° C., without the accuracy of the polarization being effected beyond the limit of error, but this is a misapprehension, against which the following argument is stated: Suppose it is required to polarize a solution of sugar using a 100 c.c. flask calibrated at 15° C., and that the temperature actually employed is not that mentioned but 20° C., then the question is to determine the error that may thus arise. In order to do this, the expansion of the glass under the influence of heat is the only matter that need be considered, and not that of the liquid, as very generally would be supposed. One must bear in mind that a litre corresponds to the space occupied by 1 cub. decimeter, and that it represents a bulk independent of the action of heat. It is evident that this invariable space is bounded by the wall of the flask and the mark on the stem, and that it will change only by the expansion or contraction of the glass. Therefore, in the case of a 100 c.c. flask calibrated at 15° C., but used at a higher temperature, it is necessary to determine only what the effect of the expansion of the glass may be on the volume contained in the flask and fixed by the mark on the stem. Glass expands 1/40,000 of its volume per degree Centigrade (its coefficient being about 0·0000085), so that if the temperature is 20° instead of 15° C. the increase in the content of a 100 c.c. flask will be: $5 \times 100 \times 1/40{,}000 = 0{\cdot}0125$ c.c.; and if a normal weight solution of pure sugar be polarized at 15° C. the reading taken at 20° C. will be $100 - 0{\cdot}0125 = 99{\cdot}9875$, or say 99·99°, which is below the error involved in the polarimetric reading. Even if the temperature be 28° C., the increase will still be negligible, namely: $28 - 15 \times 100 \times 1/40{,}000 = 0{\cdot}032$ c.c., giving a decrease in the polarimetric reading of $100 - 0{\cdot}03 = 99{\cdot}97$, which error of 0·03 is less than the limit of error permissible by German standards for the calibration of 100 c.c. flasks viz., 0·05 c.c.

Composition of Bauer Oil, the High-Boiling Residue from Molasses Fusel Oil·

C. S. Marvel and F. D. Hager. Journal of the American Chemical Society, 1924, 46, 726-730.

Bauer oil, the dark reddish-brown fraction which is obtained on the lowest plate of the fractionating column in distilleries fermenting cane molasses, boils at 130°-235°C., and consists of the ethyl esters of capric, lauric, myristic and palmitic acids, associating with a small amount of unsaponifiable material. It is suggested that Bauer oil might be utilized for the preparation of capric acid, which is present only in small quantity in the common fats.

Isolation of Sucrose from Solutions containing also Dextrose and Levulose.

S. Komatsu and M. Tanimura. Mem. Coll. Sci. Kyoto, 1924, 7, 161-163, through *J. Soc. Chem. Ind., 1924, 43, No. 26, B 530.*

Experiments are described according to which sucrose is stated to have been isolated in the crystalline state from mixtures containing also dextrose and levulose after transforming the reducing sugars into the corresponding acids by oxidation with yellow mercuric oxide in the presence of calcium carbonate, the solution being kept neutral to reduce the hydrolysis of sucrose. Then the sucrose was re-crystallized from glacial acetic acid solution.

Rate of Oxidation of Active Charcoals.

H. H. Lowry and S. O. Morgan. Journal of the American Chemical Society, 1924, 46, No. 4, 846-851.

Determinations made on 10 chars prepared from anthracite coal showed that the rate of oxidation of the samples at 450°C. is roughly proportional to the amount of chemically combined hydrogen and to the extent of surface. It was also shown to increase with the temperature of oxidation at an accelerating rate.

Filtration of Juice and Syrup with the Aid of Kieselguhr ("Filtercel") in the Manufacture of Direct Consumption Sugar

C. L. Edmunds and A. S. Elsenbast. Facts about Sugar, 1924, 18, No. 24, 562-563.

At Los Mochis, Mexico, during 1921-22 the procedure was to lime the juice to phenolphthalein neutrality, heat to 210°F, pump through Dorr clarifiers, evaporate, and remelt from the crystallizers to the evaporator syrup, treat this syrup with lime and SO_2, filter with the aid of kieselguhr ("Filtercel") and boil the filtered syrup to white sugar. During 1923-24, however, the juices were overlimed, and sulphited back to phenolphthalein neutrality, after which the procedure was the same as before until the syrup stage, when this was filtered with the aid of "Filtercel" through Sweetlands alone without any chemical treatment. Later, it was found practicable (spare time being available at the Sweetlands) to pass the clarified juice through the same filters used for the syrup. In this way it was found that the total filter area of five Sweetlands used for the juice, syrup and re-melt from 1500 tons of cane per 24 hours was 5150 sq. ft. (3·4 sq. ft. per ton of cane per 24 hours) that the "Filtercel" consumption was 1·6 to 1·9 kg. per ton of cane, the sulphur 0·51 kg., and the lime 1·54 kg. This all-juice filtration proved very beneficial in regard to the quality of the sugar produced, and also in keeping the evaporators clean.

ACID REQUIREMENT IN THE FERMENTATION OF MOLASSES (BLACKSTRAPS). *W. L Owen and J. D. Bond.* *Industrial and Engineering Chemistry, 1924, 16, No. 4, 387-392.*

One of the most important stages through which molasses passes in its conversion into alcohol is that of acidification, being second only to yeasting in its effect. Improper acidification frequently causes unsatisfactory yields. In spite of its importance, however, the control of this operation has not yet become standardized, and there remains to be developed some method of determining the acid requirement of molasses in the distillery. Apparently the rational method of so doing would be the measurement of the H-ion concentration, but this measurement has not been developed so as to be suitable as a routine procedure in the distillery Perhaps as the result of the variation in the buffer action of the salts contained in various types of molasses (which suppresses the ionization of the added acid to varying degrees) recommendations of the acid requirement differ very widely. One gallon of sulphuric acid per 1000 gallons of wort is perhaps an average figure, but some workers advise much less and others somewhat more. In experiments carried out by the authors Cuban and Louisiana molasses were fermented by the use of several different cultures of pure yeasts, while the amount of acid added was varied from 0 to 0·2 c.c. per litre. The variation in the acid requirement of the Louisiana molasses for the various yeasts used (Nos. 83 and 74 of the Scientific Station for Pure Products, New York City, *Saccharomyces ellipsoideus and cerevisiæ* of the New York Museum of Natural History, cultures X and Z from miscellaneous sources, and a Magné culture) was greater than for the Cuban product. Thus No. 83 gave the best yield of alcohol with Louisiana molasses when acidified at the rate of 1·5 c.c. of concentrated sulphuric acid per litre; while in the case of No. 74 and the Magné cultures the optimum yields were both found with 1·0 c.c. With Cuban molasses, these three yeasts all gave optimum yields with 1·25 c.c. of acid. On the other hand the variation between the maximum and the minimum yields with Louisiana molasses was lowest with the Magné yeast, and in the case of Cuban with culture No. 83. With both types of molasses, it was highest with culture No. 74; but the average yield with both types of molasses was highest with the Magné yeast, which also showed the greatest tolerance of the various acidifications of any of the cultures used. Lastly, it is emphasized that the acid requirement of any molasses for alcohol manufacture should always be determined for each type of yeast used in its fermentation.

EXAMINATION OF DECOLORIZING CARBONS, USING BLUE-VIOLET LIGHT. *J. E. Teeple and P. Mahler.* *Industrial and Engineering Chemistry, 1924, 16, No. 5, 498-500.*

In using a Hess-Ives photometer in testing decolorizing carbons for the determination of the "colour removed", the readings may be made in terms of red, green or blue-violet colour units. Any one of these can be used to advantage, or all three may be used separately, but attempts to weigh them, or to combine them by the use of factors into a fourth unit (white) result only in meaningless confusion. In the case of most commercial work, it is the blue-violet that is most strongly absorbed, and it is preferred to work with this unit. With a given Hess-Ives tint photometer and a given solution the action of any carbon on that solution may be represented on logarithmic paper by a straight line, and the comparative effectiveness or value of different carbons on that solution may be easily deduced. Within the range of commercial practice and within ordinary limits of error, Freundlich's adsorption law holds for all carbons and all solutions examined. In the present state of our knowledge, data regarding the action of carbons on one solution cannot be applied to a different solution, but each solution to be decolorized must be tested separately. Complete extraction of carbons to remove acids or alkalies and leave only the carbon, or use of buffer solutions to maintain the same pH value, is of interest in theoretical work, but in ordinary practice the only question to be answered is what any particular carbon as it is does with any particular solution. Accordingly, all graphs made by the authors represent authenticated samples of carbon as they appear in the market, excepting that all are reduced to zero moisture content.

Review of Current Technical Literature.

Determination of Sulphates in Raw Cane Juice. *H. Egeter. Archief, 1924, 32, No. 21, 509-510.*

During recent years the formation of sulphate scale has often been observed in the evaporators of certain Javan factories which do not sulphite their juices, being in this case introduced with the raw juice. In order to determine the amount of sulphate which may thus be brought into the factory, one may proceed in the following way : 200 c.c. of juice are made slightly alkaline with ammonia, 20 c.c. of ammonium carbonate (four times normal) added, the liquid boiled, 3·5 grms. of kieselguhr (sulphate free) stirred in, boiling continued, and the liquid filtered through a Buchner funnel (8 cm. diam.) under reduced pressure. After washing the residue on the filter with about 150 c.c. of boiling distilled water to which a few drops of ammonium carbonate have been added, the filtrate is transferred to a beaker, and neutralized with HCl (using methyl orange as indicator) ; then 1 c.c. of concentrated HCl (sp. gr. 1·17) is added, the liquid boiled, and while still in ebullition 100 c.c. of a boiling solution of barium chloride (containing 25 grms. of $BaCl_2, 2H_2O$) are quickly added with brisk stirring, under which conditions one may expect a precipitate of barium sulphate which may easily be filtered. After allowing the liquid to stand for a few hours, the supernatant liquid is passed through an ash-free filter-paper, the precipitate remaining being finally transferred to the filter and washed with warm distilled water till the filtrate no longer reacts with silver nitrate reagent. After drying, filter and precipitate are ashed in a weighed crucible which is strongly heated to constant weight. Then the SO_4 content in 1000 c.c. of the juice is 0·4116 × 5 × weight of $BaSO_4$, and if the result by weight is required this is calculated from the specific gravity of the juice analysed.

Extraction of Juice from Desiccated Beets. (*A*) *Ineo De Vecchis. Journal des Fabricants de Sucre de France. May 24th, 1924.* (*B*) *F. Lafeuille. Ibid., May 10th, 1924.*

(*A*) This is a lengthy article on the advantages of the De Vecchis process, according to which beets are desiccated, and subsequently extracted in the usual way in a diffusion battery,[1] two of the principal claims being that a juice of particularly high density (45-50° Brix.) and also of high purity (about 87°) is obtained. During the extraction of the juice, the loss of sugar is 1·5 per cent. calculated on the dry roots, or 0·35 per cent. on the original beets. (*B*) As the result of experiments conducted in Egypt, this writer is able to confirm the following statements made by De Vecchis : That the roots may be dried without the formation of invert sugar ; that the cellular membrane is ruptured during desiccation ; that the juice extracted from desiccated beets has a higher purity than that obtained ordinarily ; that the extraction is easier ; that the density of the juice obtained is much higher than ordinarily, it being possible to obtain syrup (of 30°Be., or 55° Brix.) with a battery of six vessels, or even in a continuous diffusion apparatus ; that clarification can very readily and economically be effected by treatment with phosphoric acid and a small quantity of lime (about 1 per cent. of the sugar, as CaO) ; and that the exhausted pulp has an exceptionally high alimentary value.

Question of the Loss of Sucrose in Beet Sugar Manufacture. (*A*) *H. Claassen. Centr. Zuckerind, 1924, 32, No. 18, 241.* (*B*) *C. Brendel. Ibid.*

(*A*) Once again the question of the loss of sucrose in beet sugar manufacture has been raised, and the possibility of working to a total loss as low as 0·7 per cent. of the roots has been recently suggested.[2] But Dr. Claassen corrects this by reproducing the statement made in his well-known book,[3] that under the best conditions of factory operation and of chemical control it cannot be less than 1 to 1·5 per cent. for the total loss, and a determined one of 0·5 to 0·7 per cent. (*B*) Dr. Brendel states that the average figure for the last 10 years in Russian white sugar factories was 1·73 for the total loss with 0·79 for the determined. In other factories in the same country a total loss of 1·1 per cent.

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[1] See *I.S.J.*, 1924, 337.

[2] *Centr. Zuckerind.*, 1924, 32, No. 17.

[3] "*Die Zuckerfabrikation*"; 5th Edition, page 313.

was returned, but in these cases either errors or miscalculations could be detected. On the other hand, Lichowitzer and Minz in their report for the 1922-23 campaign on the working of 69 Russian factories gave an average total loss of 1·61 per cent. with 0·78 per cent. as the determined, and 0·83 per cent. as the undetermined loss. However, as minimum values they state 0·58 and 0·10 per cent. respectively, that is, a total of 0·68. Therefore, it would appear from their figures that a total loss of 0·7 per cent. is conceivable, though in the writer's opinion such a low figure is extremely improbable.

Steam Turbines in the Sugar Refinery. *Karl Schiebl. Centr. Zuckerind., 1924, 22, No. 32, 554-555.*

This article is an exposé of the views, not of an interested party, but of one who has studied the question of the value of the steam turbine in the refinery in an impartial manner, namely, Herr Mrasek, Manager of the Pecek Refinery (Bohemia). In the refinery conditions are such that 90 per cent. of the heat produced is used for boiling, drying, etc., so that it is a question much less of the consumption of steam than of the consumption of heat. In the case of installations inferior to 800 kilowatts, the fact is that the reciprocating engine, if it requires less vapour per unit of power, demands contrary to the turbine more heat. Since in the refinery the problem is to arrive at the object in view with the smallest possible number of calories, therefore the turbine is more economical, and further offers the advantage compared with the reciprocating engine of furnishing dry exhaust steam having a high calorific value. Moreover, turbine exhaust steam is more strongly superheated, so that condensation losses are diminished. Further, as turbines operate better at high pressures, and as the cost of production of high pressure steam is small in comparison with the gain realized by the greater fall of pressure, here is another point in their favour. Hitherto, the principal reason of the great mistrust in the turbine in the sugar industry is the production of too considerable an amount of exhaust steam, but, if turbines have not always given the results expected, the fault is not due to these alone, rather to the engineers installing them without knowing exactly the prevailing conditions under which properly to utilize this exhaust. According to Herr Mrasek, the utilization of a considerable discharge of exhaust is quite possible in the refinery, and from his experience one can boil good strikes with steam superheated to 160°C. Assuming a boiler-pressure of 14 atmos. abs., a back-pressure of 1·5, a superheat of 350°C., one can compile the following comparative data :—

	Reciprocating Engine.	Steam Turbine
Vapour consumption, per kw.h.	11	11·4
Heat ,, ,, ...	1342 calories	900 calories
Temperature of steam on discharge ..	110°C.	160°C.

Allied with the question of the use of the turbine is the idea of electrification with its various advantages; while to the economy that can be effected by means of pressure evaporation in the sugar factory may be added that obtainable by the use of the turbine. Although the views here expressed were intended to concern the refinery solely, still they may be extended by those interested for application to the conditions prevailing in the factory making raws and whites. In fact, these conditions may be even more favourable to the adoption of the turbine.

"Rapid" Continuous Process for the Extraction of Beet Juice. *Alfred Schandler. Die deutsche Zuckerindustrie, 1924, No. 24, 645-651. Chr. Spohrmann. Centr. Zuckerind., 1924, 32, 573-577.* Calculation of the Plant Capacity and Steam Requirement of a Beet Sugar Factory. *Gustav Glaser. Centr. Zuckerind., 1924, 32, 730-732.* Recent (Patented) Processes for the Production of Decolorizing Carbon. *H. Daude. Die deutsche Zuckerindustrie, 1924, No. 24, 688-691.* Progress in the Technology of Cane Sugar Manufacture. *H. C. Prinsen Geerligs. Die deutsche Zuckerindustrie, 1924, No. 24, 685-688.*

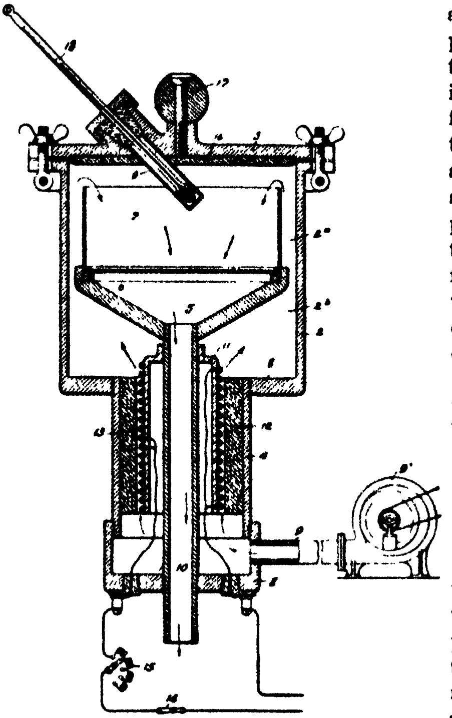
J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

DRYING OVEN FOR MAKING RAPID MOISTURE TESTS IN FACTORY CONTROL WORK. *Guilford L. Spencer*, of Herricks, Maine, U.S.A. *1,482,274*, January 29th, 1924.

Essentially the dryer consists of a shell *2*, a support *5* for the capsule 7, which has a bottom of gauze, an air inlet *9* and an air outlet *10* (the direction of the air passages being indicated in the drawings by arrows), and means for raising the temperature of the incoming air, viz., a resistant element *13*, and for increasing the pressure, viz., pump *9*. In operation, a weighed quantity of the material to be tested is placed in capsule 7 and distributed over its foraminous bottom in a layer of suitable thickness. Then air under pressure is admitted through the horizontal tube *9* so as to set up a strong current of air to pass over resistance element *13*, through the resistor of which electric current is flowing. This heated air under pressure thereupon passes into the interior of casing *2*, thence into the interior of the capsule, thence through the material to be tested and the foraminous bottom of the capsule, thence into the conical chamber within support *5* and below the capsule, and thence into the vertical outlet pipe *10* for discharge to the atmosphere or to a suitable condenser. The temperature of the inflowing air under pressure is regulated by rheostat *15*, such regulation being checked by observation of thermometer *18*. After a sufficient exposure of the material in the capsule to the current of heated air under pressure, running from about 3 mins. upwards, according to the nature of the material subjected to the test, such material is properly dried. An apparatus as disclosed permits such rapid desiccation that most materials will withstand higher temperatures than in ordinary ovens. This present invention provides a dryer having certain structural features similar to those of Patent No. 1,348,757, but it differs therefrom essentially in that the current of air is forced over the heating element and thence through the material to be dried, while important structural differences will be obvious in relation to supporting means for the capsule and the design of the parts, whereby improved guiding and confining passages for subdivisions of the air stream within the dryer are provided, and whereby the parts last-mentioned facilitate a dryer construction of great economy in manufacture and assembly. As to the important feature of a new dryer involving the use of a stream of air which is not only heated but under positive pressure before it reaches the material to be tested, it has been found that a continuous flow of air through the entire apparatus set up by a positive pressure at the inlet, as here, rather than a flow of air through the dryer established by an induced current or suction at the outlet (as in said patent) results in a markedly improved



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

operation. When the air circulation through the dryer is caused by establishing a pressure different from atmospheric at the inlet of the dryer, water evaporation in the material being tested occurs at a different rate and in a different manner than in dryers as heretofore constructed. In a dryer, where the air flow through the same is established by setting up a pressure other than atmospheric at the outlet, the air stream at the zone within the dryer where the material to be tested is located. The feature of the present invention is based on the discovery that an apparatus constructed as herein explained, may be used with great efficiency for very brief drying periods provided only that the drying period is made slightly longer than in an apparatus constructed according to said patent.

Control of Electrically-operated Centrifugal Machines. *Frank H. Jones*, of Tuinucu, Cuba. *1,475,121.* November 20th, 1923.

Objects of the invention are: (1) To provide means whereby the electric motor driving the centrifugal will, when a stop button is pushed, slow down and in so doing return power to the line. (2) To provide means whereby when the motor is slowing down an electric brake applied to the shaft of the centrifugal will stop the same at a predetermined speed at the same time that a clutch connected to the shaft disconnects the motor from a centrifugal. (3) To provide means whereby the motor is started by pushing a single button, while in speeding up to its normal operating speed, the circuit arrangements are such that the electric brake is not applied, the clutch taking hold at a predetermined speed of the shaft. In general, the invention comprises the provision of an alternating current motor which is connected through a centrifugal clutch and an electric brake with a sugar centrifugal. An electro-magnetic switching device changes the motor connexions to increase or decrease the number of poles of the motor at will. A simple push-button switch is provided, or some switch similar in action, whereby on pushing one button the motor will be connected with a given number of poles to the line and start to revolve. As the speed increases, the automatic centrifugal clutch takes hold to start the sugar centrifugal. The motor maintains its normal operating speed until it may be desired to stop the centrifugal. When this is desired, a stop button is pressed, and circuit arrangements are such that immediately the connexions of the motor are changed, whereby the number of the pole connexions of the motor are increased and the motor tends to slow down to synchronism with the line frequency. In slowing down, the motor, in a manner well-known in the art, will return power to the line, acting as a generator. When a predetermined minimum speed is reached, the centrifugal clutch will disconnect the motor from the sugar centrifugal, and at the same time circuit arrangements will be brought into play to apply the electric brake and stop the centrifugal. Simultaneously, other electrical connexions are operated, by reason of the motion of the motor shaft, to disconnect the motor from the line and to apply the electrical brake. Such a circuit arrangement, whereby the above-mentioned actions take place merely upon the pushing of a start and a stop button, are highly advantageous with respect to sugar centrifugals, which in one day of 24 hours may be started and stopped as many as 2000 or 3000 times. For reasons hereinafter to be given, the amount of power saved by this combination of apparatus and the co-operating circuit arrangement would be sufficient to run the plant for an hour.

Pressure Filter (Sweetland Type). *Ernest J. Sweetland* (Assignor to *United Filters Corporation*, of Salt Lake City, Utah, U.S.A.). *1,472,098.* October 30th, 1923.

In filters of the present type, such as illustrated and described in U.S. Patent 1,313,929, dated August 25th, 1919, the filter casing is formed in two hingedly connected parts in which a plurality of filter-leaves are revolubly mounted for filtering liquid. One object of the present invention is to provide a conveyor in the filter casing for forcibly discharging the disintegrated filter cakes from the casing after the filtering operation is completed, the said conveyor being adapted to be automatically connected to or disconnected from the driving element by the opening of the filter casing, thus enabling the casing to be opened for cleaning or other purposes while the driving element is in operation, conveyor becoming automatically inoperative upon the opening thereof. Claim 3 reads as follows: A filter including a plural part casing, one of which parts is fixed, means for hingedly connecting the parts of the casing, a filter member arranged within the casing, a screw conveyor mounted in the movable part of the casing for discharging the solid matter, a pinion carried by the conveyor, a driving pinion having a fixed relation to the fixed part of the casing, said driving pinion normally meshing with the pinion on the conveyor when the casing is closed, said pinion on the conveyor being adapted to be automatically thrown out of mesh with the driving pinion when the movable part of the casing is swung away from the fixed part of the casing.

Revivification of Animal Charcoal (Boneblack), Decolorizing Carbon, Kieselguhr, etc. *Fred W. Manning* (Assignor to *Manning Refining Equipment Corporation*, of Delaware, U.S A.). *1,475,502.* November 27th, 1923.

Animal charcoal, decolorizing carbon, kieselguhr, and the like, in the form of fine grain or granules, is revivified by submitting it to the action of a blast of hot gases containing products of combustion, which transports it and in so doing disperses it, simultaneously raising its temperature to the desired degree, the material separating and settling from the gas without substantial loss of dust. Referring to the drawing, there is shown upon a base *32* a fountain furnace comprising a preferably vertical chamber or shaft formed by the shell *4* lined with any suitable refractory material *5*. Communicating with the upper end of the furnace is the stack or flue *6*, controlled by valve or damper *7*, through which the gases are discharged either to atmosphere or to any suitable storage vessel. Adjacent the bottom of the furnace there is disposed a burner structure for mixing air to the like with combustible material, as gas, oil, or finely divided or powdered fuel. In the example illustrated, the burner structure comprises the mixing cone or nozzle member *38*, of any suitable material, such as refractory material, having a bore or aperture *37* into which projects the nozzle or outlet end *22a* of the pipe *22*. The member *38* is provided with a plurality of passages *33* communicating with bore *37* and downwardly extending passages *34*, which connect with the arcuate incomplete annular passage *17*, to which is delivered a component, as air or gas, of the combustible mixture. For example, air is delivered through the pipe *19*, controlled by the valve or damper *13*, at any suitable pressure, as atmospheric pressure or higher, to the pipe *20*, controlled by the valve or damper *18*, the pipe *20* delivering the air to the passage *17* from which it passes to the bore *37*. There may be employed, if suitable or desirable, a compressor *14* for raising the pressure of the air or gas delivered by the pipe *19*. To pipe *31*, controlled by valve or damper *30*, is delivered another component of the combustible mixture, as combustible gas, oil, or finely divided or powdered fuel, it being understood that the fuel or combustible material may be delivered through the pipe *31*, and that the combustion-sustaining gas, as air, may be delivered through the pipe *19*, or *vice versa*. When air or gaseous or

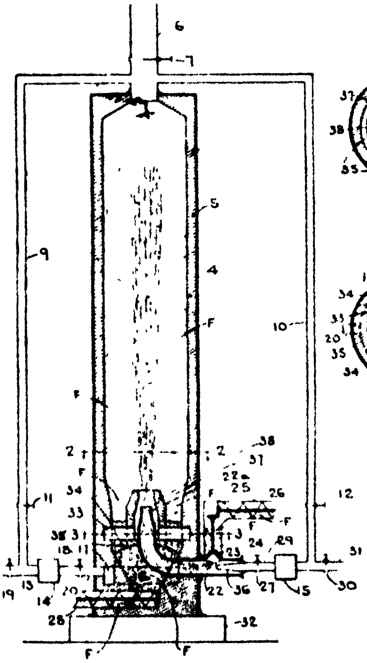

Fig 1

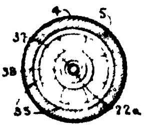

Fig 2

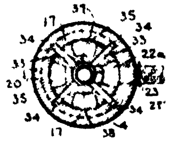

Fig 3

vaporous fuel is delivered through the pipe *31*, at any suitable pressure, as at atmospheric pressure or higher, its pressure may be further raised by the compressor *15*, which then discharges it by the pipe *29*, controlled by the valve *27*, to the nozzle *36*, from which it is discharged into the pipe *22* which discharges it at the nozzle *22a* into the combining nozzle or cone *38*, where the components of the combustible mixture come into contact or mixture with each other and are discharged upwardly from the outlet of the nozzle *38* and undergo combustion within the furnace chamber. The bone char or other material *F*, in the form of small grains or granules and advantageously in a finely divided state or in the state of powder, for example, such as will pass a sieve having 100 or 200 meshes to the inch, is delivered by a suitable conveyor *26* into the chute *24*, in which is disposed the conical valve *23* co-acting with a conical valve seat, both valve and seat having apertures which come successively into register as the valve *23* is rotated by the gearing *25*, which in turn is driven by the shaft of the conveyor *26*. The material *F* is accordingly delivered into the jet issuing from the nozzle *36*, and is transported thereby and delivered in mixture with the fuel or air through the nozzle *22a* and mixing or the combining nozzle *38* into the furnace chamber, in mixture with the air or the fuel delivered through the pipe *20* to the interior of the member *38*. Beneath the member *38* is the hopper *16* in which the finished or treated material *F* collects after descent in the furnace chamber and passage through the openings *35* in the member *38*. The hopper *16* delivers to a conveyer of any suitable type, as a spiral conveyor *28*, which removes the finished material to any suitable destination or storage. Communicating with the stack or flue *6* are the pipes or flues *9* or *10* connecting, respectively, with the pipes *19* and *31* and controlled, respectively, by the dampers or valves *11* and *12*. The rate of delivery of fuel or air from the nozzle *36* is adjustable by varying the pressure and quantity of the fuel or gas delivered, the pressure and quantity depending upon the speed of operation of the compressor *15*, if used, and the quantity and pressure being also controllable and adjustable by dampers *27* and *30*, or either of them. Similarly, the rate of delivery of air or fuel by the pipe *20* is variable, the quantity and pressure being variable by varying the speed of the compressor *14*, if used, and the quantity and pressure are also controllable by the valves or dampers *13* and *18*, or either of them. And the rate of delivery of material *F* is controllable by regulating the speed of rotation of the conveyor *26*. By using hot waste gases from the furnace chamber or stack *6*, or by using waste heat from any other suitable source, the temperature of the fluid delivered by the nozzle *36* and by the pipe *20* may be increased, as by introducing, preferably advantageously between the compressor *15* and nozzle *36*, and between compressor *14* and the discharge end of the pipe *20*, suitable heat exchange apparatus heated by such waste gas or other heated medium.

CRYSTALLIZATION OF SUGAR FROM FINAL MOLASSES (AND OTHER PRODUCTS), USING CARBON DIOXIDE AND OZONE UNDER PRESSURE. MANUFACTURE OF TABLE SYRUP FROM MOLASSES AND THE LIKE. *Elie Delafond*, of Havana, Cuba. *1,476,153*. December 4th, 1923. (Two claims; no drawings.)

Final molasses is concentrated in the vacuum pan; run into a crystallizer (preferably but not necessarily containing a foundation of crystals); the crystallizer is closed; and carbonic acid gas is introduced at a pressure of about one-tenth of an atmosphere above normal atmospheric pressure, then raised to a full atmosphere by the introduction of oxygen, or preferably ozone. It is not clear just what chemical reactions take place; but the syrupy mass becomes almost decolorized and very much more limpid. It is this limpidity which enables the crystallization to take place without any addition to its water content, and, apparently, no additional water is formed in the mass. Crystals group together much more readily, and the melassigenic action is apparently destroyed; while the carbonic acid gas appears to protect the sugar from the action of the ozone. During the action of the gases, which is twelve hours, more or less, the mass is kept stirred.

Although there is a good yield of small crystals, the inventor has found that if the mixture containing the crystals be run into open troughs to the centrifugals (as is customary at some refineries), much of the sugar will re-dissolve, due to rapid absorption of moisture from the air. Therefore, he sends the mixture from the crystallizers to the centrifugals through pipes, and when the ambient syrup admixed with absorbed carbonic acid gas and some oxygen has been removed by centrifuging (and this is done instantly), crystals which are of good colour are obtained. The proportions of the two gases as well as their pressure may be varied within rather wide limits, depending on the character of the spent molasses used. To decolorize molasses for table use, one proceeds as above described, but the molasses leaving the centrifugal machines is not concentrated to the consistency of massecuite, but is conducted directly to the crystallizer, and subjected to the action of carbon dioxide and oxygen under pressure. In this way, molasses can be completely decolorized, and may be sold without further treatment. Sugar may be bleached in the centrifugal by first removing the molasses by centrifuging, closing the centrifugal, and then introducing oxygen or ozone into the centre of the centrifugal through a pipe. The gas passes through the sugar, oxidizes the impurities and also kills ferments that have not been destroyed by boiling. The product is as white and as free from micro-organisms and ferments as any sugar that has been subjected to treatment in the refinery with animal charcoal.

EVAPORATION OF JUICE WITH SEPARATION OF GAS OR AIR FROM IT. *C. Fraisse*, of Vaucluse, France. *189,772.* November 16th, 1922; convention date, November 5th, 1921.

Juice (or other liquid) to be concentrated or freed from gas is heated to a temperature as high as possible without detriment (e.g., 75-85° C. for beet juice), and discharged through a pipe with an unrestricted outlet into a strong atomizing current of colder air. The outlet end of the liquid discharge pipe may be co-axial with the air supply conduit, and the stream or liquid may be broken up by projecting it against a disc rotated in a suitable manner, for example, by a propeller actuated by the stream.

DEFECATION OF JUICE, USING LIME, PHOSPHORIC ACID, AND SODIUM CARBONATE. *William D. Horne. 1,486,091.* March 4th, 1924.

It is explained in the introduction to this specification that a complete precipitation of the impurities in cane juice can only be attained by adding lime considerably beyond slight alkalinity to litmus; that any appreciable amount of lime left in the sugar solution is very detrimental during its subsequent heating; and that if the excess of lime be neutralized with phosphoric acid alone, or with phosphate acid to litmus in the presence of the precipitate, the precipitate will re-dissolve in part. Removal of the excess of lime in the defecation of juice by means of this reagent is best accomplished by the addition of sufficient soluble phosphate, carbonate, bicarbonate, sulphite, bisulphite, oxalate, etc., preferably neutral or slightly alkaline to litmus at a temperature of 175° F. (79° C.) or above. Phosphoric acid alone, or a phosphate acid to litmus alone, is not suitable, such reagent being far from thorough in its removal of lime. However, said phosphoric acid or acid phosphate may be mixed with the proper proportion of the oxide, hydrate, carbonate or bicarbonate, and on adding this mixture to the juice the lime is practically thoroughly precipitated.

According to the invention, to the fresh cold cane juice, the lime is added beyond the point of alkalinity to litmus and to such an extent as to be sufficient completely to precipitate all substances precipitable by lime, about 0·04 per cent. CaO of the weight of juice being required. After this addition, the juice is heated to 105-150° F. (40-66° C.) at which moderate degree of temperature no invert sugar is destroyed. After settling, the clear juice is decanted or filtered, and to the clear juice obtained is added about 0·02 per cent. of actual acid calcium phosphate and enough sodium carbonate to ensure a neutral or approximately neutral reaction to litmus in the sugar solution. Part of the acid phosphate precipitates the free lime, and the remainder reacts with the sodium carbonate to produce phosphate of soda, which immediately combines with the lime of the dissolved lime salts in the solution, precipitating this lime. The amount of the sodium carbonate is about one-third of the acid phosphate used. Phosphoric acid can be used as a substitute for acid phosphate of lime; so also may one employ phosphate of soda directly instead of forming it in the sugar solution. After adding these reagents, the temperature is raised to about 200° F. (93° C.) and the precipitate then formed is settled out, leaving a light coloured solution freer than usual from organic matter, free from uncombined lime, and almost free from combined lime.

UNITED KINGDOM.

PURIFICATION OF SUGAR JUICES, ETC., BY ELECTROLYSIS. *Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.)*, of Berlin. *214, 578.* January 4th, 1924; convention date April 18th, 1923.

According to this patent, saccharine juices are purified by electric endosmose using an anode diaphragm of quinone-tanned leather and a cathode diaphragm of closely-woven sailcloth. In preparing the anode diaphragms, hides which have been cleaned and delimed are immersed for about two to four hours in a rotary cask about one-third full of an aqueous solution of quinone of about 0·4 per cent. strength. The leather is then washed. Before use as a diaphragm it is immersed in boiling water for at least an hour to promote shrinking.

CLARIFICATION OF MOLASSES FOR THE PRODUCTION OF YEAST. *R. Hamburger and S. Kaesz*, of Freudenthal, Czecho-Slovakia. *209,034* October 6th, 1923; convention date, December 23rd, 1922.

Molasses for the production of yeast is clarified by producing it in a highly dispersed colloidal precipitate, which is then converted into a coarse precipitate either by heating or by the addition of suitable substances. The precipitate can be produced by means of an alkali silicate and an acid, or by means of aluminium salts and ammonia. To render the precipitate coarse, lime, baryta, strontia, magnesium, oxide or aluminium oxide may be employed. When the precipitate has settled, it is removed by decanting, filtering, centrifuging or other suitable means.

GERMANY.

CLARIFICATION OF SYRUPS AND MOLASSES BY SIMULTANEOUSLY LIMING AND SULPHITING OR CARBONATING.[1] *Karl Urban. 389,810.* April 8th, 1921.

If the syrups and molasses obtained from the curing of the first or second sugars in the beet factory be mixed with lime, and the excess of lime removed with CO_2 or SO_2, no appreciable increase of purity can be detected as the result of this treatment. It is necessary anyway previously to dilute them rather much. According, however, to the present invention, syrups or molasses at a density of 50-60° Brix are heated to 80-90° C., and treated simultaneously with milk-of-lime and gas (either CO_2 or SO_2), the proportions being so adjusted that the alkalinity is kept as low as possible, for example between about 0·01 and 0·10 grm. CaO per 100 c.c. of the solution. During the saturation some of the liquid is continually removed from the carbonatation or sulphitation tank, and sent to the filter-presses, the filtrate again entering the saturation tank for treatment with milk-of-lime and gas. But a considerable quantity of lime is necessary. With an addition, for example, of 100 per cent. of the weight of molasses this process produces an extraordinarily light and brilliant liquor of pleasant taste and smell, having a quotient about 10° higher than originally. This means that about 90 per cent. of the colour, 30-35 per cent. of the ash, 28-30 per cent. of the total nitrogen, and almost all the calcium salts, have been eliminated; while the precipitate has adsorbed all the colloidal substances and has also taken up the greater part of the potassium salts and nitrogenous substances as well. In consequence, the viscosity of the product is greatly lowered, and from molasses purified in this way it is possible to obtain about 25 per cent. of a very light sugar of high rendement.

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[1] For further particulars of this process, which is regarded by some as of considerable interest to the beet industry, see *I.S.J.*, 1922, 326, 549.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to July 30th	2,146,639	2,008,376
Deliveries ,, ,,	2,085,712	1,998,959
Meltings by Refiners ,, ,,	1,964,710	1,884,560
Exports of Refined ,, ,,	110,000	187,000
Importers' Stocks, July 30th	61,721	9,417
Total Stocks, July 30th	187,962	124,335
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23 Tons	1923-24. Tons.
Exports	2,377,510	2,602,339	2,505,959
Stocks	844,622	590,209	788,141
	3,222,132	3,192,548	3,294,100
Local Consumption	75,000	67,500	62,000
Receipts at Ports to June 30th	3,297,132	3,260,048	3,356,100

Havana, June 30th, 1924 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1922, 1923, AND 1924.

IMPORTS.	1922. Tons.	1923. Tons.	1924. Tons.
Refined	256,050	242,902	320,778
Raw	781,700	646,657	674,133
Molasses	53,204	77,994	103,622
	1,090,954	967,553	1,098,533

EXPORTS (Foreign).	1922. Tons.	1923. Tons.	1924. Tons.
Refined	1,248	2,682	671
Raw	6,595	10,270	4,985
Molasses	899	1,932	1,230
	8,742	14,884	6,886

HOME CONSUMPTION.	1922. Tons.	1923. Tons.	1924. Tons.
Refined	232,866	198.227	263,911
Refined (in Bond) in the United Kingdom	467,184	463,223	460,030
Raw	84,853	71,159	49,863
Total of Sugar	784,903	732,609	773,804
Molasses	4,229	5.311	3,711
Molasses, manufactured (in Bond) in United Kingdom	26,479	28,873	29,614
	815,611	766,793	807,129

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT JUNE 30TH, 1924.

	1922. Tons.	1923. Tons.	1924. Tons.
Refined in Bond	43,900	59,450	48,550
Foreign Refined	33,250	73,100	76,750
,, Unrefined	283,450	259,100	184,400
	360,600	391,650	309,700

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th July, 1924.

The market has been somewhat irregular for the last month.

The terminal market has retained its steadiness and although slight fluctuations have taken place, prices at the time of writing are 6d. per cwt. higher for old crop, and 9d. per cwt. higher for new crop, than they were on the date of our last report. This is attributable principally to "bear" coverings, and the support given by steadiness in the New York Futures Market which, for the first time for many months, has exhibited a more constant attitude in place of a series of violent fluctuations which continually resulted in further declines. The latest prices are August 23s., December 19s. 10½d., March 20s.

Trade in actual sugars—which at one time showed signs of materializing—has again been disappointing. While a fair amount of sugar of the preserving kind has been done, which is natural at this season of the year, the actual grocery demand has been comparatively poor. The Continent, who have practically exhausted their supply of stocks of surplus sugar, could not adequately meet the demand which sprang up from Russia and Spain, etc., and this has to some extent relieved the congestion in London where good round qualities have been taken out of Bond and re-exported to the countries mentioned.

The improvement in the rate of exchange on New York has brought American Granulated nearer into line with Continental prices and which, therefore, until the new crop sugars are available in November is now the only serious competitor to the British refiners. American Granulated is quoted at 23s. 9d. c.i.f. U.K.

The British refiners have reduced their prices for Granulated by stages during the period under review and to-day are 1s. 6d. per cwt. lower than a month ago. Their present prices are Cubes 42s. 9d. per cwt., Granulated 37s. 4½d. per cwt.

Business in raws has been dull. Czecho 88 per cent. Beet is offering at 15s. 3d. f o.b. Hamburg for October/December shipment. Cuban 96 per cent. have been sold down to 17s. 3d. c i.f. The Cuban production in now practically completed and the following figures represent the position:—

	TONS.
Production to date (July 19th)	3,963,000
Two Centrals still working (estimate)	87,000
Total crop estimate	4,050,000
Already exported	2,910,000
Local consumption	120,000
Stocks at ports	570,000
Balance at factories, etc.	450,000

The first shipments of Java Whites are now arriving, and the S.S. "BOCHUM" with a cargo of 5000 tons to London landed the bulk of this sugar overside for transhipment to various ports abroad. June shipment is offering at 22s. 3d., and July at 21s. 6d. Advice of exports from Java for May and June are as follows:—

	1924.	1923.		1924.	1923.
England	10,300	1,800	Japan	22,000	22,000
France	12,700	7,000	Hong Kong	43,000	30,000
Port Said	32,000	42,000	New Zealand	5,500	—
Europe	96,000	125,200	Other countries.	13,000	15,800
America	8,000	—			
British India	54,000	24,000		323,500	273,800
Singapore	27,000	6,000			

The weather in Europe still continues to be normal for the growing crops, and the increase of 1,500,000 tons which was based solely on the increased sowings seems quite assured and may even be exceeded as the first returns of the analysis show considerable improvement on last year. The following shows the results of last week's French Beetroot Analysis:—

		Same period last year.
Average weight of roots and leaves	459 grms.	against 324 grms.
Weight of roots alone	120 „	„ 76 „
Sugar contents	13·04 per cent.	„ 10·89 per cent.

21, Mincing Lane,
London, E.C. 3.
August 8th, 1924.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 309. SEPTEMBER, 1924. Vol. XXVI.

Notes and Comments.

The New Outlook for Home-Grown Beet.

Interest in political and trade circles has been aroused by the new proposals of the Labour Government for assisting the home-grown beet sugar industry, of which Mr. SNOWDEN gave an outline in the House of Commons at the end of July. In view of previous official and unofficial pronouncements on the subject of Preference generally by members of the Government, it had hardly been expected that so definite a measure of support would be advocated in this instance. But the Government feel bound to do something for agriculture at home, and the propagandists of the new industry have not found it difficult to convert them. A Bill will of course have to be brought before Parliament in the autumn to pass the proposals, and the details will then be threshed out; they will also be criticized, if not opposed, by orthodox free traders of the Liberal party, but the Conservatives, it may be assumed, will take the line that the precise method of aiding the industry is not so important in the circumstances as the fact that the industry is to be aided. So long as good results, it is not worth quarrelling over the *modus operandi* adopted by a Labour Government; it is something gained that they are out to achieve that good. Otherwise much might be made of the fact that the Government are resorting to what before the war was considered one of the most pernicious methods of aiding industry, namely, the granting of bounties on production. But other times, other manners; and while we should always prefer to see preference given by means of differential tariffs which are more in keeping with international ideas and customs, there are fewer objections to bounties when these latter are destined to aid agriculture at home to produce the home consumer's needs, and are not aimed at encouraging a surplus production for export to other sugar-producing centres. The bane of the old European sugar bounty system was that while keeping up the price of sugar in its own country it led to a large surplus being exported at prices with which the non-bountied producer elsewhere could not compete. The proposed bounty in this country is solely concerned with the production of sugar needed in this country, and the foreign supplier of sugar, in so far as he is supplanted by the home-grown quota, is no better or worse than if he had to enter this country under the auspices of a tariff. Either way, he no longer gets a free market so far as the competition of home-grown beet is concerned.

The figures quoted by Mr. Snowden of the extent of the subsidy led, as we pointed out last month, to some confusion in the minds of his hearers, and explanations have been necessary in the newspapers to clear the matter up. In some cases it has been argued that the real subsidy is no more than 9s. 9d., the difference between the 19s. 6d. given by the Government and the 9s. 9d. Excise duty which they impose. But it is overlooked that the Excise duty pairs off with the Customs duty, and after paying it home sugar is still 1s. 11d. better off than foreign sugar. On the top of this last figure comes the subsidy of 19s. 6d., which makes the total preference over foreign sugar 21s. 5d. per cwt. If you deduct the Excise from the subsidy to arrive at the net sum granted by the Government, you in effect make the home-grown sugar duty free, and it then has a further advantage over foreign sugar to the extent of the Customs duty of 11s. 8d., which brings up the total benefit to the same sum mentioned above, viz., 21s. 5d.

There should be no difficulty in getting the industry extended with a subsidy of this dimensions. It amounts to £21 8s. 4d. per ton, and even though this is not as much as was obtained before the 1924 Budget was introduced, it should not be overlooked that what the home-grown sugar producer wants of all things is stability of preference without which capital to build factories cannot be forthcoming. So long as only one of the three political parties in the House of Commons was known to be in favour of giving aid to this industry, there was no security that the aid would be continued. In fact, in sporting parlance, the odds were roughly two to one against the security being established. But now that Labour has made up its mind to bless the industry fiscally, the latter's prospects of securing the necessary capital should be greatly increased. As for the cost of the subsidy, if we assume that the output of sugar this winter attains to 20,000 tons, the Government, or rather the taxpayers, will present the industry with £390,000 during the present financial year.

New Factory Projects.

The Government's decision to aid the beet sugar industry has naturally galvanized into action a number of projects that have been under consideration but held up since the unfavourable Budget proposals were announced. More than half-a-dozen factories are now mooted.

The one most advanced is that at Colwick, near Nottingham, which belongs to the Anglo-Scottish Beet Sugar Corporation, Ltd., the Glasgow syndicate of which Lords Weir and Invernairn are the principal promoters, and of which Mr. J. B. Talbot-Crosbie (of Messrs. Duncan, Stewart & Co., Ltd.) is the managing director. This factory is about completed and is, we understand, undergoing its steam trials. Undoubtedly it will work an experimental campaign this autumn, though we do not suppose anything like its full acreage of roots will be forthcoming this year. Apart from Colwick, this corporation intends to project two other factories in the near future, though the actual sites have not yet been fixed, and a selection will have to be made from a number of likely centres.

Another well-supported group is said to have three factories in view, and in addition there are projects at Bury St. Edmunds and Southwold which have been on the tapis for some time. That at Bury St. Edmunds is being mooted by Mr. I. F. Schapringer, a Czecho-Slovakian expert, while the Southwold scheme is proposed by a syndicate of which Mr. George de Belle Ball is supposed to be the moving spirit. It may be expected that the Kidderminster scheme, to which we referred some months ago, will now come into existence, as the difficulty of obtaining capital was the only obstacle to its fulfilment. Altogether, six or more factories should be at work by the 1926 campaign in addition to the existing two at Cantley and Kelham, and four of them may start with the 1925 crop. There seems a real prospect now that a well distributed nucleus of a home beet sugar industry will be in existence in another year or two. The only possible obstacle that we can foresee is the political one that if the present Government meets with a crisis in the Autumn and goes out of office, the necessary legislation to authorize the subsidy may be held up, and if the next Government were neither Labour nor Conservative, but a Liberal one holding office by consent of the other two parties, it might withhold facilities for carrying out the present Government's proposals. The contingency is a remote one, but so long as neither the Labour nor the Conservative parties can obtain a clear majority over the other two, so long will an element of uncertainty remain as to which of the three parties will hold office for the time being, and dictate the official programme of legislation.

The British Sugar Beet Society's Activities.

The British Sugar Beet Society reports that the new development in the industry will naturally involve an extended educational movement, particularly on the technical side. It has already been giving considerable attention to the question. Professor A. R. LING, of Birmingham University, and Mr. T. H. P. HERIOT, F.I.C., of the Royal Technical College, Glasgow, have accepted the Society's invitation to join its Committee and assist them in preparing a scheme for the promotion and maintenance of a school for the beet sugar industry, such schools being one of the main factors of the success of the industry in Continental countries. Students will be specially trained for the technical posts in a beet sugar factory, theoretical instruction being given at the Universities, and practical training in the factories during the manufaturing season. In addition, the Dutch interests which have contributed very materially to the recent success of the Cantley and Kelham factories have promised every possible assistance to this endeavour to train Englishmen to take the higher responsible posts in a beet sugar factory.

Imperial Cane Sugar.

Having discussed above the prospects of home-grown beet sugar, one turns inevitably to the subject of cane sugar as produced by our possessions and Dominions overseas. It is a melancholy reflection that the year which sees the chance given to make the first substantial start with beet sugar at home should also witness from the same Government a fresh rebuff to the colonial cane sugar interests. It is perhaps a moot point whether, had Mr. Snowden's conversion to beet sugar preceded instead of succeeding the Budget of the year, he would have been quite so indifferent to the claims of cane sugar as he actually showed himself during the debates in Parliament. As it is, he has granted the beet interests as much financial interest as they asked for, only a couple of months after cutting away from underneath the cane interests the very moderate measure of preference they enjoyed. So while beet stock at home will go up, cane stock in the colonies will suffer a relapse. It has already done so with regard to one or two company flotations that have figured in our money markets this summer.

The most prominent instance has been that of the Jamaica Sugar Estates Ltd., which was unfortunately timed for flotation a few days after Mr. SNOWDEN announced his cut in the Imperial preference. It was not surprising then that when 400,000 £1 shares were offered to the public, the underwriters were left with 77 per cent. of their commitments. The public, it was evident, were shy of investing in a colonial sugar venture, one of the assets of which had been ruled out by the Budget proposals. The latest position of this company is given by a circular issued to its shareholders, in which it is pointed out that the total capital subscribed after exhausting the underwriters' liability of £250,000 was just £285,814, or £64,186 short of the share capital required to secure the Treasury loan under the Trade Facilities Acts. To secure the latter, the directors are accordingly proposing to subscribe the additional capital required to make up £350,000, but they have appealed to existing shareholders to take a hand in this making-up of the deficit. It is to be hoped that the money will be forthcoming, since otherwise a promising new sugar factory in Jamaica will fail to materialize.

Another instance of lukewarm public interest towards cane sugar ventures this year was supplied by the flotation last May of the new company to take over the Caroni Sugar Estates. The public were asked to subscribe 400,000 7½ per cent. Cumulative Preference shares of £1 each, and 400,000 Ordinary shares of 2s. each, but it was understood at the time in financial circles that a considerable proportion had been left with the underwriters. At the statutory meeting of the Company, held last month, it was admitted that profits for the year would fall short of the amount estimated in the prospectus owing to a fall in the price of sugar, while the cutting-down of the preference by 50 per cent. would adversely affect them in addition.

These are two instances of how first-class commercial ventures can have their financial arrangements damaged by the see-sawing tactics of politicians. Our sugar industry, like that of Germany,[1] wants stability in regard to fiscal enactments. Mr. SNOWDEN proposes to grant it to beet sugar interests at home. Why cannot he likewise favour our overseas sugar interests?

The Imperial College of Agriculture, Trinidad.

In our last issue we printed full particulars as to the curriculum for the next academic year of the Imperial College of Tropical Agriculture in the West Indies, but there was not time after its receipt to digest the details and write a note upon it. Such an important document cannot, however, be passed without reference, although we do not profess to be able nor indeed wish to do so in a critical spirit. Briefly, we are amazed at the comprehensive nature of the instruction offered, and only wish that when we first turned our attention to work on tropical crops there was such an opportunity of preparing ourselves for the unknown future. Every conceivable need appears to have been thought of and provided for.

When all is said and done, however, there are two factors in any educational establishment which will make all the difference between success and failure, however well conceived and endowed, namely, the characters of the teachers and the taught. As regards the former, we are perfectly satisfied that the greatest care has been exercised in the selection of the staff; and the College has been peculiarly fortunate in having the advantage of being in a position to draw upon the officers of the Imperial Department of Agriculture in the West Indies for its first professors. Such additions as it has been necessary to make have also been singularly successful, and the College is able to commence its career with a list of names well known for their work in tropical agriculture or agricultural science throughout the English speaking world.

As regards the students, a good start has been made; and it is to be specially noted that the applicants not only include natives of the contributory islands in the West Indies, but are also being drawn from the Colleges and Universities of the Old Country. This we regard as an extremely important factor in maintaining the standard of teaching, which after all must depend on the intelligence and preliminary mental training of the students; and these extra-tropical entrants consist largely if not altogether of post graduate students, often specially selected for the success of their careers in this country. These we regard as of the greatest utility in the training of the presumably larger number which will have received their education in the Colonies themselves.

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[1] See page 466.

The criticism has sometimes been levelled against the idea of having one "Imperial" College, as the present one aims at being, for the whole of the British Empire. It is urged with perfect truth that the conditions in the West Indies, and in Trinidad itself, are quite different from the great tracts being opened up in Africa and the more eastern portions of our tropical possessions: that is so, but what individual country is there which can unite all the crops and climatic conditions of the tropics? And the West Indies have the important advantage of being among the most easily accessible of our colonies, where long colonization has brought the knowledge of the cultivation of the soil to a high state of perfection. The Imperial Department of Agriculture has for many years been a fruitful recruiting ground for officers taking up important appointments in various tropical colonies and, if we are not much mistaken, any one wishing to take up an agricultural post in the tropics, will find it a great advantage to be able to display the diploma of the College among his testimonials, or in any other way to show that he has had the advantage of the training given there.

It is our hope that the local needs of the different parts of our tropical Empire, will, in time, be largely catered for in a series of Colleges on the spot; but it is not at all likely that, with the exception of India, any College will be established on the same scale at that of the Imperial College of Agriculture for many years to come, and this alone fully justifies the promoters in assuming this imposing name. For the rest, the net is cast so widely that it is difficult to mention any need not catered for in the prospectus. Special instruction is provided for the administrators and managers of estates and their subordinate officers, officers in charge of experiment stations, technologists in special branches, scientific workers and so forth; while room will be found for such workers in temperate climates as wish to enlarge their horizon by short studies under tropical conditions. The founders of the College have done their part, and it only remains for those desiring to profit by the opportunities offered to see that these are used to the utmost.

Mr. Farnell's Sugar Research Work.

Since his appointment in 1921-22 as chemist to the British Empire Sugar Research Association, Mr. FARNELL has published several papers giving the results of the investigations he has carried out in this country and in the West Indies. It may now be of some general interest to state in language as clear as possible briefly what this expert has accomplished to date.

Mr. FARNELL at once directed his attention to the colloids of cane juice, having recognized the great importance of this subject, since, as NOËL DEERR has stated in a well-known paper,[1] "the clarification of cane juice is essentially a precipitation of matter in the colloidal state."

"Matter in the colloidal state" indicates a condition which many chemical compounds may assume, and living matter, vegetable as well as animal, is for the most part built up of substances existing in this state. By way of explaining some of the nomenclature of this special study, it may be said that when a solid is in admixture with a liquid, a *colloidal solution* is represented when the particles composing the solid are sufficiently small that the mixture remains homogeneous, even after long standing. If, on the other hand, the particles composing the solid are coarse (or, technically speaking, less highly dispersed) so that on standing they separate from the liquid, this mixture would only be a *suspension*. If again the solid were dispersed throughout the liquid in particles of molecular magnitude, then a *true solution* would exist. Therefore, it will be seen that a colloidal solution is intermediate between a suspension and a true solution.

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[1] *I.S.J.*, 1916, 562.

Colloids are distinguished from crystalloids, or substances forming true solutions, by several important properties. One of these, observed by the Scotch chemist THOMAS GRAHAM about the year 1861, is that colloids diffuse only with difficulty through permeable membranes, whereas crystalloids rapidly pass through such a wall; while another phenomenon is that of adsorption, or the concentration of a substance on the very considerable surface which is represented in the aggregate by the comparatively small mass of the particles composing a colloidal solution. Examples of colloids occurring in sugar manufacture are "gums" and waxes, and examples of crystalloids are sugar and salts. In the paper alluded to above, DEERR stated that colloids are mostly emulsoids. This means a type of colloidal solution consisting of a concentrated substance suspended in a liquid composed of a much diluter solution, and these emulsoids include substances of a very viscous character. Another expression used by DEERR was to the effect that the colloids of cane juice are irreversible, which means (as indeed the term suggests) that when separated from the solvent medium they do not again pass into solution unaided.

Many chemists have emphasized the very important effect of colloids in sugar manufacture,[1] but so far little organized work has been carried out on the subject. Mr. FARNELL has begun a systematic research on the identity and properties of the colloids of cane juice, realizing that such substances play a primary part in clarification, and in boiling and crystallization, especially in connexion with the elimination of the "gums" and colouring matters. In a comparatively short time he has obtained results of some interest.

Thus, he has shown the following colloidal substances to be present in mill juice: Protein (principally albumin); pentosan and pectin (both derived from cane fibre), tannin, wax and silica.[2] He has examined methods of estimating the amount of pectic substances (pectinogen and pectic acid) in cane fibre.[3] He has studied the rôle of pectin and pentosan in clarification, and has demonstrated that while the former constituent is removed in alkaline clarification, the latter is not eliminated, and continues to persist throughout the manufacture till it accumulates in the final molasses, although in the carbonatation process it is precipitated, probably as the result of its adsorption on the granular calcium carbonate at the time of its formation.[4] He has followed the behaviour of albumin in the liming and heating processes of clarification, and has confirmed the observation that if the lime be added to the heated juice this protein is more completely eliminated than in the usual procedure of liming in the cold and afterwards heating.[5] He has investigated the effect of superheating unlimed juice in relation to Muller's theory of the presence of colloidal silicious compounds and their decomposition at a high temperature, and has proved that part of the silica present is in this way precipitated.[6] Then he has determined the actual amount of colloids (separating them from the crystalloids by dialysis), and it is surprising to notice how small an amount of these substances he found to be present, the importance of their presence thus being made evident. Even in the molasses in which these substances have become concentrated, the total amount, including mineral matter (probably colloidal silicic acid), was only 1·1 to 2·1 per cent.; while in juice it was only about 0·03 per cent.[7]

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[1] See *I.S.J.*, 1924, 420 for a review of this literature.

[2] *I.S.J.*, 1924, 420-427. [3] *Ibid.*, 1923, 248-251, 630-636. [4] *Ibid.*, 1923, 630-636.

[5] *Ibid.*, 1924, 358-362. [6] *Ibid.*, 1923, 358-362. [7] *Ibid.*, 1924, 420-427.

From the above it will be seen that Mr. FARNELL has carried out a series of interesting preliminary researches, which later may lead the way to results of value to every cane sugar manufacturer. Since his initiation into our industry, he has in a remarkably short time hit on one of the most likely lines of investigation. It is to be hoped that he will receive full encouragement to continue this research work, which he has begun so well.

Jamaica Agriculture during 1923.

In his annual report of the Jamaica Department of Agriculture for the year 1923, Mr. H. H. COUSINS, the Island Director of Agriculture, observes that from the departmental point of view the year in question was chiefly remarkable for an active campaign against Mosaic disease which threatened to become a serious menace to the canefields of the island. But co-operation on the part of the planters was freely given, and effective control is now being rapidly effected in all the chief sugar-growing areas. Uba cane has proved to be of great service in this campaign, as it is immune to mosaic and is a very strong and hardy grower in Jamaica, giving a larger tonnage than any other cane grown in the island. The sugar industry has found itself in the tantalizing position of having a splendid market for its sugar and latterly a good demand for rum with a production seriously curtailed by three years of drought. The estates in Vere have suffered most severely, despite great efforts to deal effectively with the inadequate supplies of water for use in irrigation.

The exports of sugar in 1923 were about 26,000 tons valued at £675,000 as against 50,000 tons valued at £914,000 in 1922. Rum was greatly reduced in output by every means, and only 5370 puncheons were exported of a value of £51,765. For the current year, however, Mr. COUSINS remarks that prices are still good for sugar while rum is in brisk demand, and many estates should now be able to see themselves on a safe basis after the tragedies of 1921.

At the Hope Experiment Station there are 35 seedling canes obtained by crossing Uba with large West Indian varieties. It is hoped from this line of breeding to obtain for use in Jamaica, as has been effected in Java, a resistant cane that will enable planters to deal with mosaic in an effective manner, and which will yield larger and more profitable canes than the small reed-like Uba. The small settler, says Mr. COUSINS, has been found a hopeless person for dealing with mosaic by "roguing," and the only salvation of this class of cane cultivator will be the provision of an immune cane suitable to his requirements. An order prohibiting the growing of corn (maize) in contiguity to sugar canes has been issued. It is important for the small growers to understand that mosaic is even more destructive to corn than to sugar cane, and that it is in the interests of corn as well as of sugar cane growers that those two plants be kept apart. The corn harbours the carrier of the disease (the corn aphis), while the cane supplies the virus for infecting both cane and corn. In order to assist the campaign against mosaic, it has been found necessary to establish several new sugar cane nurseries, situated in the parishes of Clarendon and Westmoreland, while proposals for others in the parishes of Trelawny and St. Thomas have been approved and will shortly be carried out.

This advice with regard to mosaic and corn is, one notes, also strongly presented by Dr. MARIO CALVINO, the new director of the Cuban-American Sugar Company's sugar experiment station at Chaparra. He recommends that corn and canefields should be separated by a distance of at least 500 metres; he also advises that when more than 10 per cent. of the cane in the field is infected it should be cut down and burned, while when the entire field is badly infected, he recommends that it should be rooted up and planted in Uba cane, which he considers is as good a variety as any other.

German Sugar Interests Amalgamating.

According to a Berlin Correspondent of the *Times*, the Verein der Deutschen Zuckerindustrie recently held a meeting at Breslau, when several questions of great importance to the future development of the industry were considered. One of them was the proposal to amalgamate with the Verband de Rübenverarbeitenden Fabriken (Association of Raw Sugar Factories). After negotiations between the two organizations, the differences between them were settled and the meeting at Breslau accepted the proposal for amalgamation. If the details of the scheme are approved at the next meeting of the Association of Raw Sugar Factories, the German sugar industry will be united in one big organization. Other important items on the agenda were the demands for taxes on imports and for freedom of export next season. These taxes on imports should, it was proposed, be levied in proportion to the export bonus granted in the country of origin. In regard to free export, there are differences of opinion between the sugar factories and the refineries. The latter are opposed to the export of raw sugar, as it would mean a reduction in the quantity available for refining. The raw sugar section of the industry has, however, consented to a repayment of import tax to the refineries for sugar imported for refining, provided a corresponding amount of white sugar is allowed to be exported.

As to the general condition of the German industry, there will be found on another page a report from our Continental correspondent, which shows that while German sugar production is slowly increasing, the industry still labours under great difficulties. The principal one is lack of ready money wherewith to pay the usual cash for the roots delivered to the factory, for, contrary to what might have been supposed, credits are still difficult to arrange with the banks. The latter have been the subject of a special appeal on the part of the sugar industry, and an American combination of bankers has also come to their aid. The chief other difficulty is the lack of stability in the matter of sugar legislation. The industry is tired of all the interference on the part of officialdom that has marked the last decade, and wants to pursue an undisturbed career for some years to come with the regulations and taxes stabilized.

New Factories under Construction in Cuba.

We learn there are three raw sugar factories under construction in Cuba at this time. Two are in the Province of Camaguey, and one in that of Oriente. One of the factories is being constructed of machinery taken from another factory of the same company. In fact the Company is reducing the capacity of one of its factories by one half, in a district where there is a scarcity of cane for the full capacity of the factory as it stands today, and erecting the machinery in a district where there is a plentiful supply of cane. This will allow both units to work at full capacity, and the machinery, though divided and in separate factories, will produce more sugar than it did when all was under one roof.

The other two factories are being erected in new districts. But we believe very little new machinery will be installed in them, the boilers being the principal new items. The greater part of the machinery will be bought locally, and will be second hand, or machinery which has been lying in Cuba for some time unsold. These two new factories will add a stimulus to cane growing in their respective districts, and on their second crop should make between them some 40,000 to 50,000 tons of raw sugar.

Fifty Years Ago.

From the "Sugar Cane," September, 1874.

Lengthy extracts from the published statements of authorities on the influence of forests on rainfall had been reproduced in various articles in previous issue of the *Sugar Cane*, the purpose in view being to show that the most eminent meteorologists and travellers concurred in connecting the existence of trees and water supply. These opinions were summarized in this number of our predecessor, the following points in particular being considered: That the existence of forests produces rain; that the cutting down of forests is followed by diminished rainfall; that the planting of trees is followed by the formation of springs of water; and that the destruction of forests is followed by the drying up of springs.

Evidence was also deduced showing that trees increase the amount of rainfall by lowering the temperature; by intercepting and (as it were) tapping the vapour-charged clouds; and by superseding "the state of tension and polarization existing when an electrified cloud is above them, silently discharging the electricity," thus inducing rain.

Lastly, it was concluded that "the list of compilers of the evidence and the witnesses include some of the foremost men of science and travel that have adorned the present century, and also of experts who have made the investigation of this subject their special study. So convincing has this evidence proved, that Governments on every side have become alive to the question, and departments have been organized and large sums of money have been spent in order to preserve the trees . . . ." These articles on rainfall, written by Alfred Fryer, at that time Editor of the *Sugar Cane*, had been instigated by the practice being followed at that time in certain cane-growing countries of denuding the land of trees.

P. Casamajor had an article in this issue "On the Expansion of Sugar Solutions by Heat," and after describing in much detail the method of procedure he gave a table summarizing his results for the coefficient of expansion for various degrees Balling of sugar solutions, the "relative expansion of 1 c.c. of sugar solution of 23° Balling for a rise of 1°C. being 0·00023 c.c."

Brinjes Brothers described their continuous method of revivifying animal charcoal in two revolving cylindrical retorts, the material being fed in at one end of the upper drying one, traversing its length, and falling into the lower reburning cylinder, through which it travelled until it was discharged into a cooler. This type of apparatus was believed on the whole to be superior to the stationary kiln, and especially to be suitable to small scale operation. Replying to the objection that much waste is incurred by attrition when this rotary principle is adopted, they stated that during any kind of reburning a carbonaceous covering is formed around the grains, which, in the revolving kiln, is broken, and the porosity of the char thus preserved. A certain amount of dust was formed, it was acknowledged; but this, it was claimed, was more than compensated by the finer samples of liquors obtained from char reburnt according to this system, compared with those drawn from char revivified in pipe-kilns.

An indication of the comparative activity of various countries in chemical research is obtained according to E. J. Crane[1] "with considerable accuracy" by the number of papers noticed in *Chemical Abstracts* due to each. Thus, he finds that for the year 1923 the percentage of the total number due to the leading countries was as follows: United States, 32·1; Germany, 27·0; British Empire, 15·4; France, 11·3; Holland, 2·2; and Belgium, 2·19.

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[1] *Industrial and Engineering Chemistry*, 1924, 16, No. 7, 754.

The Condition of the Sugar Industry in Germany.

(By our Continental Correspondent.)

According to official statistics the beet sowings in the German Empire for the 1924-25 season amount to 351,371 hectares against 335,642 hectares for 1923-24; 265 factories will be active during this campaign against 268 last season, which latter figure, it must be observed, embraced four establishments in which the beets were worked up into table-syrup only and not into sugar.

The 1923-24 crop has yielded a quantity of 1,130,000 metric tons of sugar raw value, and although the area sown this year is only 4·7 per cent. greater than its predecessor, yet the sugar crop is expected to increase by much more than that percentage, since in 1924 the weather has proved much better than in the rather unfavourable season of 1923.

Although definite figures as to the probable output of the coming crop are not yet available, the results of the preliminary tests of beetroots produced in different centres of the country point to a good weight of roots and a fair sucrose content. We believe it not to be too far amiss if we estimate the next German sugar crop at a minimum figure of 1,250,000 tons raw value, with a great probability of a still higher total.

Turning our attention to the sugar consumption in the German realm, we are again astonished at the ever-decreasing figures issued by statistical quarters. During the period September, 1923—June, 1924 Germany consumed no more than 681,104 tons of sugar, raw value, against 1,113,912 tons in the corresponding period of 1922-23. This figure corresponds to a total consumption during 1923-24 of only 817,000 tons, or the lowest on record for a very long time.

One knew that conditions of life were rather miserable for large sections of the German people and one knew also that during the depreciation of the mark huge amounts of all kinds of materials, among which sugar was a very prominent one, were hoarded and are now coming into consumption without appearing in the current statistics; but one never supposed that the use of sugar would have dropped so low as now appears to be the case.

This small consumption has counterbalanced the influence of the low sugar production, which was no less than 300,000 tons under that of 1922-23 and has left so much sugar in the country that the Government can allow large amounts of sugar to be exported. First 80,000 tons were scheduled for export, then further quantities of 50,000 and 100,000 tons followed, so that out of the 1923-24 crop at this moment 230,000 tons of refined sugar may pass the frontier and have already done so to a very great extent.

For the 1924-25 crop authorization has already been granted for 200,000 tons, of which 100,000 tons may be exported as refined and the other half in the shape of raw sugar, whereas up to now, only refined has been allowed to be exported.

The great difficulty encountered by the German sugar industry, which it shares with every other German kind of enterprise, is the lack of ready money and the impossibility of obtaining the necessary credits between the period in which payments are to be made and that in which the product finds its purchasers. During the period of the uninterrupted fall of the mark, everybody was eager to dispose as rapidly as he could of his ready money and to invest it in materials, buildings, etc., with the result that now it is very hard to find the necessary means to finance the crop.

The Board of the Association for the German Sugar Industry has addressed the following notice to the Reichsbank in Berlin. "The General Assembly of the Association for the Sugar Industry considers the actual lack of credits to be the greatest danger for the economical development of agriculture and of sugar industry, and requests the Reichsbank to take such measures as will remedy against this lack, as it menaces our industry with ruin. With a view to the great importance of the German sugar industry to the food supply of the nation and for the general welfare of the country, it is of urgent necessity to develop the cultivation of beetroots and to secure the entire working up of its produce into sugar. In order to enable both agriculture and the sugar industry to fulfil their duties towards the nation and the country, it is indispensable that sufficient credit be put at their disposal and the assembly urgently requests you to take such measures to grant them credit as will be needed to avert ruin."

In the meantime the sugar manufacturers have addressed themselves to other quarters too, for we read in the financial papers that a consortium of American bankers, under the guidance of the Equitable Trust has granted a loan on the security of sugar to the German sugar industry. The amount of the loan is said to be 4 million dollars, which on the basis of 2 cents per pound, will finance over 100,000 tons of sugar, or more than half of the quota to be exported. The cheques issued by the sugar manufacturers are endorsed by German banks and sent to the United States, after which the credit is forthcoming. The rate of interest is 7 to 7·5 per cent. per annum and the duration of the loan is restricted to six months. If the Reichsbank likewise comes to the rescue, it might be possible for the German sugar industry to overcome this year's difficulties without incurring too heavy costs.

But it is not only the immediate future which occupies the mind of the sugar manufacturers and refiners; they eagerly want some stabilization of the sugar politics of the Government. Since the first days of the war every effort of the governing powers has been of a spasmodic character and only intended to supply some immediate need. Every now and then new regulations were made, amended, remodelled, suspended and cancelled, all of which has created a sensation of unrest and uncertainty, very detrimental to the maintenance and development of the industry. Everybody concerned wants a period of stability, in which no new ordinances have to be studied and obeyed, but in which the industry may follow a path planned and arranged for a long period of time.

During the meeting of the General Assembly of the Association for the sugar industry, held at Breslau on the 13th July last, the following resolutions were voted by the great majority present:—

"Exportation of raw as well as of refined sugar should be entirely free.

"So long as the general tariff in Germany has a protective character, a protective duty should be levied on foreign sugar, on importation, of at least 20 marks per 100 kg., to which should be added a compensatory duty to the amount of the export premium in case the sugar to be imported enjoys such a premium in its country of origin.

"The duty shall be refunded to the refiners in case they work up the raws by affination.

"An excise duty shall be levied on home grown sugar, which shall be valid from 1st October, but be collected only six months after the day when it is entered into the books."

The section of raw sugar manufacturers was opposed to the free importation of molasses, but was in favour of its exportation.

The refiners were opposed to any freedom to export refined, advancing the argument that such was detrimental to the general interest of the industry, but nevertheless the majority adopted the contrary view. In the draft of the resolutions the excise duty had been fixed at 14 marks per 100 kg., just as before the war; but after discussion the assembly dropped that figure, and only asked for an excise duty without mentioning its amount.

The "Times" on the Sugar Beet Question.

In a recent letter to the *Times* LORD DENBIGH, who claims 25 years' association with the beet sugar question in England, referred to the possibility of Parliamentary opposition to Mr. Snowden's proposals to assist homegrown beet sugar and asked whether this was being egged on by the big refiners whose monopoly was being threatened. He said that in this country the factories had found out that it paid best to turn out their sugar as a finished product rather than as raw sugar, because there were ready markets near at hand which could readily absorb the output. About two years ago the Kelham and Cantley directors went into the whole matter with Messrs. TATE & LYLE, Ltd., and decided that the price offered by the latter for raw sugar would not pay the factories as well as turning out the finished sugar themselves. LORD DENBIGH also asked why if Sir LEONARD LYLE professed to be anxious to help British agriculture, he did not come along and take a hand with the beet sugar interests. He and his friends had the capital and the technical experience and then if they turned out British grown sugar, they would be helping British instead of foreign agriculture, and they would have their full share of Mr. Snowden's subsidy. If Germany was this year in a position to export a considerable amount of raw sugar, would any of this find its way to Messrs. Tate & Lyle's refineries as in pre-war days, to the distinct benefit of agriculture in Germany?

The *Times* commented on the letter in a leading article, from which we reproduce the following, as showing the reasonable view our leading press organ takes of the matter.

"Mr. SNOWDEN has approved, because he is convinced of its soundness, the policy which LORD DENBIGH and the National Sugar Beet Association have advocated since the first British sugar factory was built at Cantley in 1912. According to Lord Denbigh's estimates, an equipment of fifty factories, with a total of about 400,000 acres under beet in any one year, would, on a four-course system, necessitate the keeping of over 1¼ million acres under clean cultivation within an economical distance of the factories; would mean the employment of some 40,000 extra farm labourers, besides about 30,000 men working in the factories during the four winter months; and would produce about 300,000 tons of sugar per annum. The fact that he is not alone in his confidence in the prospects of the industry as a business proposition is shown by the recent announcement that two such experienced men as LORD WEIR and LORD INVERNAIRN are building a sugar beet factory near Nottingham, at a cost of £300,000, and intend to develop their enterprise by erecting others in various parts of England and Scotland. So far, therefore, Mr. Snowden's proposed subsidy appears likely to produce the results at which it aims. But objections have been raised to its confirmation in Parliament by the great sugar refiners of the country, on the ground that it would constitute an intolerable and indefensible injustice. It is not fair, they argue, that this encouragement should be given to one class of British subjects as against another class engaged in a similar occupation. Without saying so in so many words, they practically accuse LORD DENBIGH and his associates of poaching on their preserves, and they fail to see why they should do so with State aid. If the beet-sugar manufacturers were to stop at the point where the juice of the beet is crystallized into a dark and impure raw sugar they would apparently have nothing to say against their receiving the subsidy, which they themselves, as refiners of imported raw sugar, do not enjoy. But because the manufacturers, in order to make their business as profitable as they can, have ventured to undertake the futher process of refining the raw sugar, the established refiners deprecate their entry, with the subsidy at their back, into the field of competition which they used to have to themselves. As against these complaints, it is to be observed that whereas the refiners deal mainly with imported sugar, the operations of the beet sugar manufacturers are wholly confined to the homegrown article; that Lord Weir's suggested fifty factories would only produce 300,000 tons of sugar out of the country's present imports of about 1¾ million tons; and that the subsidy is only to be granted at its maximum figure for four years, and will disappear altogether at the end of

ten. Because of the threefold effect which the industry, if properly developed, would have—in the revival of agriculture, in the bringing of more land under the plough, and in the increase of employment to which it would lead—the case for the subsidy is so strong that it is to be hoped that Mr. Snowden's proposal will meet with the approval of all parties in the House. It will not be the first time that an infant industry has received State aid in its early stages, nor the last when such assistance will seem to its competitors to be unwarranted "

The Present Position as regards Mosaic in Cuba.

The mass of literature on the mosaic disease of the sugar cane has now assumed such proportions that it is no longer possible to present all the current aspects of the subject in any detail in one article. Such an article was attempted in 1921 in this Journal,[1] and only some of the more recent papers could be dealt with; but since that time the progress of investigation has been so rapid that it has been found impossible to refer to all the advances made, although some nine or ten papers have been presented to our readers during the interval, dealing with new facts elicited and new views advanced in various countries and by various observers. A complete summary is therefore neither possible nor called for at the present juncture. But there are certain sides of the question which are in need of summarizing and clarifying for the sake of the general reader. For instance, the so-called "spread" of the disease has so enlarged the list of countries where the disease is found that its range may now be confidently stated to include the whole sugar cane world. The search for a causative organism has been persistently pushed forward by various expert mycologists in different countries, and several rival theories have been in consequence put forward, each with much plausibility. Then in the study of the incidence and importance of the disease from a crop point of view, various differences of opinion have been arrived at, which only tend to make the matter more puzzling to those not accustomed to intricate biological reasoning; and it will be well if it be possible to straighten out some of these inconsistencies, with due regard to the local conditions under which the cane is being grown.

There are clear cut stories of sugar cane mosaic in Java, Hawaii, Porto Rico, and Louisiana; we have much interesting information regarding Natal, Jamaica, Trinidad and the Philippines, and a certain amount of knowledge regarding Barbados, Mauritius, Egypt and India, and so on. But there are still the larger islands of the Caribbean Sea, San Domingo and especially Cuba about which very conflicting reports have from time to time been published; and, considering the important position being taken up in the world's production in these sections, a trustworthy local account is very much to be desired. In the circumstance there is thus room for a further article of a general nature on the mosaic disease, and we have had much pleasure in reading such a one which has recently come to hand, written by JOHN R. JOHNSTON[2] at the instance of the United Fruit Company, for whom he is acting as Director of their Research Department. This paper does not profess to deal at all fully with the whole subject, but in its 35 pages there are included studies of the practical side of the question, which after all are just what is wanted at the present time. The tone is impartial and the author's vote on any question is given after a careful summary of the different views expressed; and, in consideration of his long experience in tropical agriculture and his intimate knowledge of certain countries, his opinions carry weight and may be generally

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[1] *I.S.J.*, 1921, pp. 12-19.

[2] "The Mosaic Disease of Sugar Cane in 1923: A discussion of the problems up to date." JOHN R. JOHNSTON.

accepted. Cuba is largely dealt with because of the great interests of the United Fruit Company in the sugar industry of that island, and we have obtained a very fair idea of the conditions as regards mosaic from the perusal of this pamphlet. The following notes have in the main been extracted from its pages.

The symptoms of the disease.—These have often been described and are now sufficiently understood for control work to be carried out without any difficulty. But it is obviously unwise for those not fully conversant with these symptoms to form hasty conclusions as to the presence of the disease; this has in the past led to a good deal of confusion as there are many other leaf markings in the cane. It must be remembered that, in the search for diseased plants in the field, the stage of growth of the leaf is of considerable importance; and it is safest in diagnosing to confine one's attention to those of a certain age. Thus the mottling is not observable in very young shoots, but is most clearly shown on young leaves which have reached their full development; later on the markings tend to fade away, till little is left of them in old leaves. Less attention is now being paid to the manifestation of cankerous growths on leaf and stem, than was at one time the case, for in places they are not observable at all and, in any case, as they can only be found in old plants (largely ratoons), these should not exist when control is being properly carried out. GREY at Soledad—who often appears to find himself in complete disaccord with other observers—asserts that this cankering is caused by drought in Cuba; but the author examined the canes carefully in Cuba in the drought of 1923 and only found the cankers in some of the mosaic infected stools, but none in any which did not show the disease in the leaves.

The relation of mosaic to the soil.—Here again GREY claims that by manuring diseased plants, transferring them to better soil or giving them good cultivation, he has succeeded in curing the disease. The comprehensive work in Porto Rico by STEVENSON, however, showed that although the severity of the attack could be reduced by good treatment it could not in any way rid the plant of the disease. Excellent cultivation and deep ploughing were tried, and proved entirely useless from the point of view of control, and manuring had not the slightest effect in the same direction. LYON and KUNKEL in Hawaii have obtained evidence that plants have occasionally recovered after being attacked, but GREY is alone in saying that he can cure the disease.[1] Attempts have been made to correlate the effects of mosaic with drought, but, on the other hand, it is the general opinion that the mosaic spreads more rapidly in rainy weather. In Porto Rico it is admitted that the most serious damage is met with in hilly limestone districts, which of course also suffer more from drought than the low lying country.

The effect of planting diseased cuttings.—This is generally conceded to be fatal, in that the plants raised are invariably diseased too. But the results have not been altogether concordant, and some workers including GREY have raised plants with a low percentage of infection from diseased cuttings. Such discrepancies may possibly be explained by the following facts, as noted by C. B. WILLIAMS in Trinidad. The infection of a fresh growing plant with the disease is assumed to be due to a sucking insect attacking the leaves; at any rate it commences there, and WILLIAMS has shown that the progress of the disease from the point of infection down the stem to the underground parts and up the other stems of the clump is a comparatively slow process. This being the case it is not unreasonable to assume that cuttings taken low down may be perfectly healthy even though the young leaves show the presence of mosaic. The author concludes that the only safe rule in judging the infection of any joint is to examine its own leaf, not always possible when old stems are being used as seed material.

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[1] Zeno's contribution to the problem will be remembered in this connexion.

The Present Position as regards Mosaic in Cuba.

The infectious nature of the disease.—This has been demonstrated many times. As an instance, an experiment by **Bruner** in Cuba is given, in which he planted 49 cane varieties from healthy parents in rows, which alternated with other rows sown with Crystalina cuttings obtained from diseased plants. Six months afterwards it was found that 76·5 per cent. of the plants produced from the healthy sets showed signs of disease, in 20 of the varieties this being present in every stool of the row. Similar results were obtained by **Stevenson** in Porto Rico, **Brandes** in the United States and **Lyon** in Hawaii. **Brandes** put 17 varieties, all diseased, into an insect proof greenhouse which contained certain insects under observation. From time to time he then introduced healthy cane cuttings grown in pots, and invariably within two to three weeks they showed signs of mosaic. The same author, on January 8th, 1920, inoculated ten healthy plants with juice from diseased ones, at the growing points of their shoots, the juice being protected from contact with the air and thus simulating the transfer of juice by a sucking insect. By February 6th to 14th eight of the ten inoculated plants showed signs of mosaic, while no trace of it appeared in the control plants. This attempt to transfer the disease by inoculation has been made many times without success, as it appears to be an operation of some difficulty; but **Brandes** ultimately succeeded also by employing various other methods. As a result of his greenhouse experiments, **Brandes** found that one out of many insects tested might be relied on to pass the infection, namely the corn aphis (*Aphis maidis*), and this has been confirmed by **Willbrink**, **Kunkel**, **Bruner**, **Chardon** and other workers. The study is however one of great difficulty, in that this insect does not appear to regard the sugar cane as one of its food plants, and is often very difficult to find in the cane fields. But it has been observed that a very small sojourn of the aphis on its leaves is sufficient to bring disease to the sugar cane, if it is present on the surrounding grass weeds. Such visits would be rarely observed, and the further difficulty is met with that the period in incubation of the disease in the cane is sufficiently long for all traces of any such visit to have been in many cases completely removed, before it can be said that mosaic is present. **Grey** denies this infectiousness of the disease and traces its fresh appearance entirely to soil conditions, and in proof thereof gives a case where no increase whatever was observed. The author examined this field and noted the exact number of diseased plants: he again visited it one year later and found that **Grey**'s observation was perfectly correct. But, after all, this is no proof that insect transmission does not occur, and the absence of increase was probably simply owing to the absence of the insect in the particular field examined.

The presence of a causative organism.—**Matz** in 1919 isolated an organism from diseased cane plants of some plasmodial type and regarded it as a possible cause of the disease; but subsequently he did not find this organism constantly associated with mosaic. **Kunkel** in 1921 found bodies of a protozan type in corn mosaic and was also able to identify similar bodies in the tissues of sugar canes with mosaic disease. More or less similar bodies were observed in tobacco mosaic as long ago as 1903, and **Nelson** more recently, in a paper on mosaic in beans, clover, tomatoes and potato, made clear drawings of protozoa- or trypanosome-like bodies: it has however here again been demonstrated that exactly similar bodies have been also found in healthy tissues. The matter of a causative organism in cane mosaic disease has therefore not at present been settled, but the author regards it as probable that the cane and other mosaics are due to some micro-organism, either ultra-microscopic or of a protozoan nature.

Losses due to the disease.—Great diversity of opinion has all along existed in this matter, and it seems probable that at times considerable exaggeration has occurred. At Soledad in Cuba no loss has been observed either in the sucrose in the juice or in tonnage of canes when the canes are attacked by mosaic. On the other hand, the early reports from Porto Rico were truly alarming. Thus FIGUEROA in 1919 gave the following among many other estimates of the decrease in outturn in batches of mills in different tracts during 1917-1919:—In six mills 18·3 per cent., in seven mills 39·7 per cent., in four mills 39·4 per cent., in eight mills 10·8 per cent., in one mill 50 per cent., in eight mills 22·2 per cent., and in others near the last 34 per cent., it being specifically stated that other factors likely to be of influence had been taken into account. FIGUEROA believed that the greater part of this reduction was due to the mosaic disease. Taking the total production of the island these figures would appear to be corroborated, as in 1917 the total sugar produced was 503,081 tons, while in 1919 it had fallen to 406,002; and in 1920 the figure was 485,070, it being stated that mosaic had then been brought under control. But in 1915 the production was only 346,490, while again in 1923 it only reached 397,071. Thus the relations between losses and occurrence of mosaic are not sufficiently clear to warrant the use of total crop figures in this connexion.

Reverting to carefully conducted experiments, however, we get much more reliable results. LYON in Hawaii in 1914, planting diseased and healthy cuttings, obtained 101·13 tons of canes from the healthy plot and only 56·24 from the diseased. EGERTON in Louisiana obtained in plant canes 19·89 tons from selected seed and 17·37 from unselected, after three years 14·00 and 10·58, and in the fourth year 13·94 and 11·45, respectively. Similarly, in Jamaica HANSFORD reported a loss from mosaic of 15 to 45 per cent. But it must be noted that in these cases the diseased plots were infected to the extent of 100 per cent., and such fields are comparatively rare in Porto Rico and much less observable in Cuba: in fact no such case has been noted in the latter island, the worst seen by the author being 60 per cent. If we accept the highest loss reported by HANSFORD, namely 45 per cent. in fields infected 100 per cent., this would be 27 per cent. in fields infected to the extent of 60 per cent. But the great majority of fields in Cuba have nothing like this percentage of infection: numerous fields could be mentioned with 10, 6, 4, 2, 1, 0·25, 0·1 per cent.: many fields do not have over 1 per cent. and many have no infection at all. In those with 1 per cent. infection the loss works out at about 200 lbs. of canes per acre, and this may be taken as accounting for practical men not thinking that the disease is to be considered seriously.

But the matter is greatly altered now that we know that the disease is infectious, and it is obviously the duty of the planters to get rid of the diseased plants for this cause alone. The only way to be sure of avoiding such losses as have been mentioned above is to plant healthy seed; and the feasability of doing this, if necessary, will obviously depend on the extent to which ratooning is carried on. Thus it would appear an easy matter in Porto Rico, where replanting occurs every one to three years on the average; but in Cuba with an average of 10 to 15 years it would be a much more serious piece of work. It has been noticed that the losses vary a good deal according to crop being grown, whether plants or ratoons: loss is likely to be most serious when ratoons are grown from diseased plant canes, less so when canes are grown from diseased sets, and least when healthy plants are liable to secondary infection.

Control.—As to the control of the disease JOHNSTON refers in detail to the résumé prepared by BRANDES, published in 1919. A schedule of roguing is given, provided that it is an advisable proceeding, But generally if the infection is found to be over 20 per cent. the loss in millable canes is likely to be too great from an economic point of view; then the canes should be grown on and milled but none of them used for planting purposes. Where infection is heavy, however, it will be advantageous in small fields to rogue thoroughly because of the danger of infecting the larger fields near by. If roguing is to be done it should commence at the earliest possible moment, the shoots being inspected as soon as they are well sprouted; the infected plants should be thrown down between the rows that they may dry up, for in that condition they are not visited by insects and therefore dangerous as sources of infection. It is not certain from this first inspection that secondary infection is not taking place, and therefore a second inspection should be made 25-30 days later; some of the shoots might be in the incubation stage when the first inspection was made. If no fresh cases are observed it may be assumed that secondary infection is not taking place, and the plants should remain healthy till the harvest. If, on the other hand, new cases are found in the second inspection, this suggests that infection is taking place, and further inspections at the stated intervals must be continued till no further diseased plants are observed. It must be remembered that the effectiveness of insect carriers will be reduced by the continued removal of infective material. This method is said to have met with complete success in Porto Rico, where the cost has been estimated as varying between 50c. and $18 per acre. Even at the lowest figure, if it is necessary to continue the practice year by year, say, because a neighbouring estate does not rogue, this will entail a heavy annual item of cost in the cultivation. It is probably owing to this expense that in Porto Rico many planters have given up the system, and that there is a tendency to rely more on the introduction of immune or resistant varieties, in itself also a costly proceeding. The author comments on the general absence of any definite experiments on the control of the aphis, and of corn and sorghum and its wild hosts.[1]

A detailed account is then given of the distribution of mosaic. In Cuba the first published report was made by him in 1919, although seen previously by LARSEN of Hawaii. EARLE has spoken of the loss sustained by Crystalina, the standard cane of the island, of 20-50 per cent., but the author states that he has not met with any such case. In certain cases where the loss was reported as severe it was found on examination that the canes were suffering from extreme drought and poor soil; in the same field uninfected plants were seen to be stunted while infected plants next to them were growing luxuriantly, and this has made any attempt at judging the losses more difficult. A general statement is given of the distribution in different districts of the island. While JOHNSTON was in charge of the Cuban quarantine station the alarming reports from Porto Rico led to his inducing the Government to pass a law against the introduction of canes into the island or of transporting canes from diseased districts to others for planting purposes. But lack of money has prevented these steps from being taken.

On the whole, one would judge from this pamphlet that the stage in which the mosaic disease exists in Cuba may be very different from that in some other islands, whether from a general absence or rarity of carriers or any other cause; and it is very desirable that exact information should be obtained as early as possible as to the necessity or otherwise of more energetic action being taken by the planters than appears to be the case at present. The danger is there, and the experience gained elsewhere suggests that the sooner the matter is thoroughly investigated the better for the future of the sugar industry in the island. C. A. B.

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[1] See, however, Jamaica's action in passing a law against interplanting corn or sorghum and sugar cane, mentioned in another part of this Journal (p. 474-476).

Experimental Agriculture in Jamaica.

The Campaign against Mosaic.

The sugar industry of Jamaica has not been very fortunate of late years. There has been a very considerable development, but this has to a large extent been more or less confined to the press; and the rapid rise "to a standard of 100,000 tons per annum" forecast in the Annual Report of the Department of Agriculture for 1919-20 still hangs fire. Perhaps the greatest misfortune was that year of sugar shortage and consequent high prices, which left in its train such a series of acute crises in the sugar industries the world over. But, besides this, Jamaica has certainly had very bad luck, short crops when the prices were high and low prices when the crops were large, a serious depletion of staff when scientific work was commencing, and during two recent years a cumulative drought leaving the rainfall 43 in. short of the average.

During the past year the island as a whole appears to have been fairly prosperous; for, although the sugar exports were only 26,000 tons, the situation was saved by an easy record in the banana trade—sugar's greatest rival in places—when well over two million pounds were received for 12½ million bunches. Nothing like such a value is recorded previously in the table for the past 22 years, presented by the Director of Agriculture in his Annual Report for 1923. But the vacancies in the scientific staff appear to have been more or less completely filled up again, and they have most of them been concerned in the year under report in a determined attempt to reduce the ravages of mosaic in the cane fields, and thus to lay a better foundation for any prospective development of the industry. The Superintendent of Agriculture, after four months' work on foot and mouth disease, spent the rest of the year on mosaic, and the plant breeder, entomologist, and micro-biologist also devoted the major portion of their time to the subject; so that it is evident that the Department is seriously tackling this disease.

The Superintendent of Agriculture reports that, with the assistance of the micro-biologist, a careful survey was made of the canefields, and that the result of this was the conviction that mosaic was making rapid strides, especially in Westmoreland (in the extreme west) and Clarendon (the southern half of the middle part of the island), in some cases reaching 100 per cent. infection over large areas of cane. A regular campaign was organized and public meetings were held in various places. As a general rule the planters showed themselves to be quite alive to the danger, and the effect of these meetings was to set about the languishing control work with renewed vigour. Two additional plant inspectors were added to his staff, nurseries of healthy plants were put down on almost all estates, and a mosaic law was passed, which will be referred to below.

The Superintendent of Agriculture remarks that he considers that the Uba cane is destined to play an increasingly important part in the sugar industry of the island, very much in the same way as it has done in Porto Rico; already there are at least 2000 acres under this cane, and one or two estates have fairly large areas planted. In St. James (on the west of the northern side of the island) one manager reports 300 acres and regards it as 50 per cent. more valuable than the standard White Transparent grown on his estate. In an estate in Trelawney (east of St. James on the northern side) there are 100 acres of Uba planted on land which was saturated with mosaic, and the manager reports that, acre for acre, it has given 50-75 per cent. more sugar and 100 per cent. more tonnage than the White Transparent there. Many planters have thus far urged two objections to the Uba cane, namely, that it has poorer juice and takes longer to mature than the local kinds. But it is stated that at the Hope Gardens at 17 months the juice of the Uba equalled that of the White Transparent; while as regards the length of time that it requires to mature, this is no greater than the varieties mostly grown in the island. For instance, these canes do not succeed as spring sown crops, but are planted in the fall, because then they have the advantage of a season of 16–17 months in which to mature. The matter is to be thoroughly tested during the next season.

An interesting summary is given of some of the results of the present campaign. In Trelawney it is said that the spread of mosaic has been checked on all estates where the infection was under 10 per cent., and in the majority of the fields it has been reduced to under 1 per cent. One factory manager started by offering 1s. for every 100 diseased roots brought, and these were easily found; but now the price has been raised to 14s. a hundred and the labourers find it difficult to spot them. On another estate the attorney offered the labour £5 if in one month the overseer was unable to detect a diseased cane. Where the infection has been found to be over 10 per cent., arrangements have been made to replant with Uba. The Trelawney planters are congratulated on thus energetically attacking the disease in its early stages.

In Westmoreland the work of eradication is being concentrated on the fall plants, of which there are large areas. These have been systematically rogued with a general reduction of infection from 5 per cent. to under 2 per cent. Some estates have, however, neglected the sound practice of planting only healthy seed, and roguing of their fields is now impossible; these will be replanted with Uba. Arrangements have been made for a vigorous campaign as soon as the planted fields begin to sprout, and each estate has put down a nursery of Uba cane to be used in case of emergency.

In St. Catherine (on the south coast just west of Kingston), on the large estates the disease is under control as the result of systematic roguing. On the Bernard Lodge estate the infection has been reduced from 2 per cent. to 0·1 per cent. alike in plants and ratoons, and 300 acres of magnificent canes are recorded in which mosaic cannot be found. In other estates it will be necessary to give closer attention to the fields, and in one case 50 acres will have to be replanted, as the disease is bad.

In the Vere section of Clarendon (west of St. Catherine) systematic roguing has been conducted during the year and the percentage of infection considerably reduced. The disease has only just appeared here and the planters are taking it in good time. The rest of Clarendon (further from the south coast) is the worst infected portion of the island. This is put down to the current practice of planting corn near the cane. In Denbigh estate the work of control is being energetically taken in hand, and it is becoming difficult to find the disease in the plant canes; the ratoons however will have to be replanted in 1924, and this will be done from a Uba nursery 100 acres in extent which has been put down. In the remainder of the estates of this section the work is only undertaken in a half-hearted manner and the results are unsatisfactory. In order to encourage the spread of the Uba cane the managers of Denbigh and Sevens estates have announced their intention of paying the same price for these canes at the mill as for those of other varieties.

The Plant Breeder reports a continued demand for cane tops from Hope Gardens nursery, the distribution during the year having been 225,116 as against the record established in the previous season of 426,449: the varieties most sought after were Uba and BH 10 (12). POJ 100 and BSF 12 (24), (34) and (45) were rejected because of yield inferior to White Transparent, and D 625 because of susceptibility to mosaic. The seedlings already obtained by crossing Uba with other varieties are being grown on and will be tested in 1924; but there is no chance of any additions being made to this series because the Uba cane did not flower in the Gardens. Mexican Striped and Badila are being grown on for distribution as they are reported to be highly resistant to mosaic. There were large distributions of cuttings also from Montpelier Experiment Station (in St. James). The total number for the year was 229,190, although the demands for Uba could not altogether be met. The following were the chief varieties distributed: Uba 115,645, B 208 25,553, B 6450 15,430, D 625 12,702, White Transparent 10,715.

The work of the Government Entomologist was largely concentrated as far as the sugar cane was concerned on the study of insect vectors. His experiments were however confined to those insects which he considered to be the most likely, and as aphids were not sufficiently in evidence they were not included. Negative results were obtained with the rest, namely the sucking insects common in the fields, *Kolla herbida*, *Stenocranus saccharivora* and Peregrinus. The Micro-biologist appears to have thrown himself into the mosaic campaign with energy, lecturing at various centres, and carrying out the detailed survey in company with the Superintendent of Agriculture. As a result of his study he became convinced that the interplanting of cane and corn was responsible for the spread of the disease and observed that this system was in parts very common among the small growers. Whenever the two crops were planted near one another the canes were noticed to be very badly affected. An order was therefore, as already stated, drawn up prohibiting the practice; and, as sorghum was also found to be subject to mosaic, this crop was included.

C. A. B.

The 1923-24 Cuban Sugar Crop.

(From our Havana Correspondent.)

Although there are still two sugar mills grinding at the date of writing (August 8th) we can consider the sugar crop for 1923-24 as at an end. The final output will be over 4,000,000 tons, and will constitute a record for the country. As stated in a previous communication, the high sucrose content of the cane contributed largely to this result. Another factor, of course, was the improved work done in most of the factories, whereby they obtained a higher percentage of the sugar in the cane than in previous years.

We will now tabulate the amounts of sugar "estimated to be made" and "made" by provinces, and from these total up just what each Province has produced. The figures given are in round numbers, but can be taken as quite accurate:—

	Tons of 2240 lbs.		Increase or Decrease.
Province.	Estimated.	Made.	Per cent.
Pinar del Rio	141,100	135,500	— 3·9
Habana	301,000	339,500	+ 12·7
Matanzas	478,500	508,900	+ 6·3
Santa Clara	787,000	904,000	+ 14·8
Camaguey	1,156,600	1,186,100	+ 2·5
Oriente	1,060,700	1,061,100	+ 0·03
	3,924,900	4,135,100	+ 5·3

Note.—The above is calculated on bags of 325 lbs.; but with slight short-weights and loss caused by handling in transit, the delivery weights will not quite reach the above figure.

It will now be interesting to look at the output of the factories, and the table below gives one a good idea of the manufacturing capacity of the 181 factories grinding in Cuba. The smallest output for any single factory was a little over 2 tons, while the largest outputs were 112,330 and 109,410 tons respectively.

Number of Factories	Production.
3	under 1,000 tons.
10	made from 1,001 to 5,000 tons.
32	,, 5,001 ,, 10,000 ,,
30	,, 10,001 ,, 15,000 ,,
29	,, 15,001 ,, 20,000 ,,
27	,, 20,001 ,, 25,000 ,,
9	,, 25,001 ,, 30,000 ,,
14	,, 30,001 ,, 40,000 ,,
13	,, 40,001 ,, 50,000 ,,
5	,, 50,001 ,, 60,000 ,,
3	,, 60,001 ,, 70,000 ,,
4	,, 70,001 ,, 80,000 ,,
0	,, 80,001 ,, 90,000 ,,
0	,, 90,001 ,, 100,000 ,,
2	made over 100,000 tons.
181	Average output, 22,845 tons.

The foregoing table is interesting in that it shows that more than one-half of the factories have a capacity ranging from close on 10,000 tons to 25,000 tons. Nevertheless, the trend, where the cane supply allows it, is to bring the capacity of the factories up to 40,000 and 50,000 tons.

Prospects for the 1924-25 crop.—The prospects for the coming crop are on the whole quite favourable. Ratoon canes have sprung well, and where the rainfall has been good, the growth has been vigorous. Reliable reports from various parts of the Island all indicate a satisfactory spring season, and give good accounts of cane growth. On the far eastern end of the Island, the condition is much better than it was last year at this time. Fair showers have fallen which have stimulated the ratoons, and brought along nicely the new plantings which have been quite extensive. In this district the tonnage of cane in view is much ahead of last year's figures. New plantings have been carried out all over the country, and in some districts those plantings have been quite extensive. They have had a good spring, which means they have had a good start, and should the weather be favourable, those plantings should be ready for harvesting this coming crop.

At the moment of writing there has been a short dry spell in many districts, but so far it has not affected the cane to any noticeable degree. Should rains come soon, this dry spell will not be felt. So it is apparent that everything is in favour of another big crop, and should the weather not go against the present prospects, the next campaign will exceed the 4,000,000 ton mark.

According to a writer in a Liverpool paper, that centre handles over 40 per cent. of all the sugar refined in this country, producing approximately 400,000 tons per annum. There are four refineries giving employment to over 3,000 hands.

American sugar circles are awaiting with some interest the details of the report of the Tariff Commission on the sugar duties. It is said that a majority report recommends a reduction in the existing import duty, while a minority report urges the retention of the existing rates. The report has gone to the President and awaits his consideration; till he has dealt with it, which may not be for some time, it is not expected to be made public; and the general belief is that nothing is likely to be done in the immediate future to change the existing sugar duties. In any event, if the President decides to make a change in the tariff, any reduction effected cannot exceed 50 per cent. of the present rate.

The Origin of the Ubá Cane.

By ALFRED J. WATTS.

Referring once more to the question of what is Ubá (oo'báh) cane and whence it came, I came across this name, last May, in a telegram in a Pernambuco newspaper in connexion with some political matter, in a town with this name situated in the State of Minas Geraes in Southern Brazil. It occurred to me that I might throw some light on the question of the origin of this name by inquiring from the local authorities and I addressed an inquiry to the Secretary of the Sociedade Nacional d'Agricultura of Rio as the most likely to be able to assist me. I extract below the most relevant part of his reply published in *A Lavoura*, the organ of that society, of Sept., 1923, (Anno 27, No. 9). He writes:—

"As to the name "Ubá" given to a town in the State of Minas Geraes and its possible connexion with the cane with that name, we can find nothing relevant in either ancient or modern works referring to cane cultivation or sugar manufacture.

"However, in the 'Diccionario Geographico do Brazil' of Caetano Lopes de Moura, ed. of 1845, p. 738, appears:—'Ubá, new settlement of the Prov. of Minas Geraes, near the River Parahibuna. Had its origin in an engenho (old-style copper-wall factory), which belonged to Joao Rodigues Pereira d'Almeida, whom King Dom Joao VI decorated with the title of Barao of Ubá. The dwellers in his district, half Indians and half whites, of divers nationalities, gather a good lot of coffee, grow canes, and bitter cassava and other provisions for their consumption, and export to Rio de Janeiro much coffee and some sugar and rum.'

"This notice makes us, in fact, suspect that the origin of the name Ubá given to this village of Minas was directly connected with the pre-existence locally of an indigenous cane, thus named, and especially owing to the reference to the cultivation of this graminaceous plant by the Indians, without mention being made of any importation of varieties of plants. This is the conclusion which appears to be most logical.

"In face however of the information of Caminhoá, in his Botany, vol. 2, p. 1794, sub-title *Graminaceas industriaes* (industrial grasses), our opinion comes again in doubt. He says:—'Canna do Reino (cane from the Kingdom, or Mother-country—Portugal), or Ubá in the south of Brazil. Arundo Donaz. L. var? (Donax arundinacea), Palisot de Beauv., Sclochloa arundinacea. Paisot, (? Palisot) and Koch, good for cages and various other uses.'

"Again on the same page:—'Ubá verdadeira (true Ubá) (gynerium paroiflorum. Nees d'Essemb.), from which the natives make arrows, and which serve for divers objects of domestic use also.'

"It is a fact that we, here in the south, have always known as Ubá, or of the Kingdom of Portugal, the cane which furnishes sticks for cages, traps, sky-rockets, etc. It is possible that, by analogy, confusion, or even want of words, or expressions, the original settlers called the true sugar cane also Ubá, and to confirm it Vieira also tells us, in his Dictionary of the Portuguese Language, 'Ubá. sm. Brasilian expression. Wild cane, which gives arrows (sticks), which serves for making the lath-work of adobe houses, for fencing and split for faggots, or for lanterns, for lighting with torches, and for killing dazzled fish.'

"What appears to us most probable in all this, in face of what remains after reading the documents on the subject is that, although contradicting the hypothesis, otherwise very praiseworthy, of our consultant, the word Ubá may be only a Brazilian, or originally Portuguese corruption of the word "uva," name that natives give in India to the sugar cane (*saccharum spontaneum, var. officinarum*), which again in its turn shows some similarity with another word "uga" given also to the plant in Tahiti.

"This deduction is more in conformity with the notion which we have of the origin of the sugar cane in Brazil. In reference to this, says Burlamaqui on p. 11 of his "Monographia da Canna de Assucar," published in 1862 in Rio de Janeiro, 'The most general opinion and that which appears best reasoned is that the sugar cane is indigenous to the regions beyond the Ganges, whence it came and spread over all the places where it is now cultivated.' Burlamaqui further states that Dr. Freire Allemao in his *Memorial* published in the Review of the Historical and Geographical Institute, vol. XIX, 1856, discusses the question—Whether the cane was met with indigenous to Brazil at the time of its discovery. For this he consulted all the historical documents he could find, compared them, analysed them, and from all these examinations drew the following conclusions, which may be logically adopted :

"To Brazil it is the most probable that it came from Sao Thomé (St. Thomas), where the ships generally were re-fitted, which sailed to India and to Brazil; and where the sugar industry had greatly developed, Professor Domingos Vandelli asserting that there were 60 engenhos in 1492. Now, on what basis Frei Gaspar affirmed that Martin Affonse had it brought from the Island of Madeira, I cannot say. Following however my method of interpreting these facts, which perhaps errs systematically, it is not impossible that this belief originated in the way I am about to explain. The association formed in Lisbon with the object of making engenhos and to carry on the sugar business, would have sent to Madeira for good sugar boilers, etc., for this work, in the phrase of Joao de Barros, and in this supposition I am supported by Frei Gaspar himself, when speaking of the nobility of the first colonizers of St. Vincent, he says: 'Antonio Lemo, Fidalgo of Madeira . . . . . . it is supposed he came over on the same occasion as when Martin Affonso sent to fetch from Madeira the cane plants' and as it appears to me that I have shown that this did not happen, I opine that this fidalgo came in company of the sugar masters (boilers), to whom it is customary to attribute the bringing of the canes.

"This is what at the moment we can furnish to the consultant on the history of this precious 'grass.'"

The above information appears still to leave it an open question, without doubting the known fact that the Portuguese and others brought the sugar cane to the Western Hemisphere from the Mediterranean and the Atlantic Islands in their wake, whether it may not have existed in a more or less wild state in other parts of that huge continent formed by North, Central and South America. The evidence of various writers among the first colonists that they met it in places as far apart as the Mississippi district and, by the Jesuit padres, in Rio de Janeiro State, is at least worthy of some consideration. As ethnologically there is so strong a connexion between the South American native and the Japanese, it is quite justifiable to suppose that the sugar cane may have come in from the Pacific coasts of the continent ages before its (the continent's) recognition, or so-called discovery, by Europeans. Following the same argument the reed-like "Ubá" cane may have been that primitive cane. In any case the evidence adduced by the worthy secretary of the Soc. Nacional d'Agricultura of Rio is not all against the pre-Columbian existence of some kind of sugar cane in Brazil.

Pernambuco.

The Pectin and Pentosan Content of Cane Juices, Syrups, and Molasses and its Removal.[1]

By R. G. W. FARNELL.

In a previous report the author dealt with the pectic substance of sugar cane fibre, its extraction, and its precipitation by calcium hydroxide in the absence of sucrose.[2] The present paper describes work[3] on (*a*) The pectin and pentosan content of juices, syrups, and molasses; and (*b*) The removal of pectin and pentosan from solution.

(A) Pectin and Pentosan Content of Juices, Syrups, and Molasses.

(*1*) *Pectin Determination.*

(*a*) *Juices.*—500 c.c. of juice of known Brix are boiled for two minutes and filtered by suction through a Buchner funnel, thus removing the heat-coagulable protein, which is necessary before carrying out the Haynes-Carré[4] method of pectin analysis. The filtrate is diluted with washings to about 700 c.c. and then neutralized (approximately) with N/10 caustic soda. An excess of 30 c.c. of the caustic soda is then added and the solution left at least two hours, preferably overnight; 25 c.c. of N/1 acetic acid followed by 25 c.c. of M. calcium chloride solution are run in, and the juice boiled two minutes. This usually at once precipitates the pectin as calcium pectate, unless there is only a trace present, in which case the precipitate takes some time to form. After leaving overnight, the precipitate is washed by decantation, and when sucrose-free is boiled with 50 c.c. water and filtered through a tared Gooch crucible, or ash-free filter-paper. Drying for four hours at 105° C. is sufficient before re-weighing. Alternatively, the calcium pectate may be separated by centrifuging, as described below for molasses.

(*b*) *Syrups and molasses.*—For syrups 75 grms., for molasses 15-20 grms., are diluted to 6° Brix, and treated in the same way as for the juice pectin estimation, except that no initial neutralization is necessary. Owing, however, to the high colloidal content, the filtration of the precipitated calcium pectate was found extremely slow, and recourse was made to the centrifuge, which gave a much quicker method of separation than decantation and subsidence.

An electric cup centrifuge was used running at 4000 revs. per min., the force being 2250 times gravity. The total capacity of the cups was 40 c.c., and it was found possible to collect and wash the precipitate in an hour. The calcium pectate was finally transferred to a beaker in which it was boiled with 50 c.c. water, and filtered through a Gooch as usual. The sugars and nitrogen compounds present in cane products undoubtedly exert a stabilizing influence on the calcium pectate, which entails waiting 24 hours to ensure its complete precipitation. Centrifuging may possibly accelerate the separation.

(*2*) *Pentosan Determination.*

It is necessary to separate first the pentosan by alcohol precipitation in order to free it from substances that interfere with the subsequent determination by the Tollens-Kröber method. The precipitation of this alcogel depends chiefly on: (*a*) Alcohol concentration; and (*b*) Hydrogen-ion concentration.

STEUERWALD and VAN DER LINDEN[5] showed that if the precipitate occurred in a greater alcohol concentration than 70 per cent. by volume, calcium salts of organic acids and even sugars are thrown out besides the pentosans. This has recently been confirmed by RUFF and WITHROW.[1] Regarding the hydrogen-ion concentration, the Java workers used two acids, acetic acid and hydrochloric acid. At the date when their work was done the colorimetric method of determining the pH had not been devised, while the electrometric method was not in general use. Considerably less total precipitate was obtained with hydrochloric than with acetic acid. Moreover, the acetic-acid-alcohol precipitate contained more organic as well as more mineral matter. The chief difference between the two precipitates was found in the fact that whereas acetic-acid-alcohol precipitated the organic calcium salts, these were absent from the hydrochloric-acid-alcohol precipitate. (The writer has found the following value for the pH of the acid-alcohols, acetic-acid-alcohol, pH 4, hydrochloric-acid-alcohol, pH 1.)

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[1] Report made to the British Empire Sugar Research Association. Here published (in slightly abridged form) by kind permission of the Association.

[2] *I.S.J.*, 1923, 630.

[3] It had to be conducted out of the cane crop season, with somewhat immature cane ground in a small 3-roller hand mill. Hence the juice was somewhat deficient in the particular substances examined. Nevertheless the results described in this paper should be applicable to factory conditions.

[4] *Biochem. J.*, 1922, **16**, 60; *I.S.J.*, 1923, 631.

[5] *Archief*, 1914, **22**, 1033.

Table I.

	Juices.	Calcium Pectate, per cent. Brix.	Pentosan, per cent. Brix
(A)	Cane, chiefly D625, from 11-roll mill (Demerara)	0·13	not determined
(B)	Uba cane, 10 months old, from hand-mill (Trinidad)	0·015	0·040
(C)	Bamboo cane, 11 months from hand-mill (Trinidad)	0·010	0·036
(D)	Trinidad Experiment Station seedlings, 9 months old	No precipitate	0·044
(E)	Same juice, cane cut 10 days before grinding in hand-mill	No precipitate	0·049
F)	Juice D, after standing seven weeks, preserved with mercuric chloride	No precipitate	0·065
	Syrup.		
	Juice crushed in a 3-roll mill (Barbados)	0·015	0·069
	Molasses (Defecation).		
(A)	Trinidad, 11-roll mill	0·33	0·55
(B)	Trinidad, 11-roll mill	0·70	0·45
(C)	Trinidad, 14-roll mill, with Searby shredder	0·60	0·72

Consideration of the results of the Java workers mentioned, and of HAZEWINKEL and STEUERWALD,[2] led the writer to adopt the following method for precipitating as completely as possible the furfural-yielding substances present in cane products, excluding the hexose sugars.

(*a*) *Juices.*—400 c.c. of juice concentrated *in vacuo* to about 90 c.c. and made up to 110 c.c. Two portions of 50 c.c. are pipetted into two conical flasks and 270 c.c. of 90 per cent. (by vol.) alcohol containing 20 c.c. of N/1 acetic acid run into each flask, which is well shaken, and allowed to stand overnight. In the morning the precipitates are filtered off through either Gooch crucibles, or filter-papers (Whatman No. 42, 11 cm.) and well washed with 90 per cent. alcohol. If the weight of the total precipitate is required, it is necessary to dry for four hours at 105°C. Otherwise the filter can be roughly dried for about half-an-hour, transferred to a distilling flask, and the furfural distilled off in the usual way. Using filter-papers it is necessary to determine the amount of furfural phloroglucinide precipitate when the paper is distilled with the 12 per cent. hydrochloric acid and substract this from the phloroglucinide precipitate obtained from both paper and pentosan. Actually only 3 mg. of precipitate was given by the Whatman No. 42 paper. In all cases the precipitate was extracted with hot alcohol to eliminate any methyl-furfural phloroglucin. It was found in practice that the duplicate determinations agreed as closely as could be expected, the total error never exceeding 6 per cent.

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[1] *Ind. Eng. Chem.*, 1922, 14, 1131.

[2] *Archief*, 1913, 19, 313.

(*b*) *Syrups.*—50 grms. are transferred to a conical flask using 10 c.c. of water; 20 c.c. of N/1 acetic acid are added to 270 c.c. of 90 per cent. alcohol, and the acid-alcohol poured into the conical flask. The subsequent procedure is the same as already described for the juices.

(*c*) *Molasses.*—10 grms. of molasses are transferred to a conical flask using 10 c.c. of water; 20 c.c. of N/1 acetic acid are added to 270 c.c. of 90 per cent. alcohol, and the acid-alcohol poured into the conical flask. The subsequent procedure is the same as described above.

The results of the determination of the pectin and pentosan contents of various juices, syrups and molasses are given in Table I.

From an examination of the above results, it is obvious that there is no correlation between the calcium pectate and pentosan figures. However, the furfural produced from the glucuronic acid constituent of pure calcium pectate only corresponds to about 25 per cent. of pentosan, while the calcium pectate separated from molasses only yielded about 10 per cent. of pentosan, as shown by the following analyses (on the same molasses as in Table III).

Table II.

Molasses.	Pentosan, per cent. Calcium Pectate.	Calcium Pectate Pentosan, per cent. Total Pentosan.
(A) Trinidad, 11-roll	12·3	7·5
(B) Trinidad, 11-roll	9·0	13·7
(C) Trinidad, 14-roll	8·3	8·4

From Table I it appears that the amount of pectin and pentosan in the juices expressed by the hand-mill is extremely small, as is also the case with the Barbados syrup. Only in one case (A) was a pectin analysis made on a factory juice, and here the pectin was very much higher, though unfortunately there was no opportunity for estimating the pentosan in it. Steuerwald and Hazewinkel[1] found very much higher pentosan figures for various mixed juices (factory mill juices), varying from 0·25 per cent. Brix to 0·38°, the juice expressed from the final rolls containing from 0·77 per cent. to 1·21 per cent. Brix. Moreover, in the first expressed juice of a 9-roll mill they found scarcely any pentosan. This then accounts for the low figures obtained in the Trinidad juices expressed by the hand-mill.

Steuerwald's observation that the amount of pentosan in the juice increases with the interval of time elapsing between cutting and milling has been confirmed in one case, as will be seen from the figures for the Trinidad seedling cane. A much greater increase, however, was found for the juice (F) that was analysed after standing seven weeks preserved with mercuric chloride. The increase in pentosan may have been due to the solution of xylan from the fine particles of fibre in the juice, though it had originally been strained through 100-mesh gauze. This large increase in pentosan is not at all clear.

From the few varieties of cane studied, it is not possible to draw any conclusions on the variation in pectin and pentosan content. It is interesting to note that the Uba cane did not give any markedly increased amount of pentosan, though its pectin content was higher than the other juices from hand-ground cane.

The high purity Barbados syrup (made from juice of cane crushed in a 3-roll mill and defecated with only a very small amount of lime) contained much the same amount of pectin and pentosan as the hand-crushed Trinidad cane juices.

With the molasses a great increase in both constituents was found, due both to the higher mill extraction and the removal of the greater part of the sucrose. It is interesting to see the effect of the shredder in molasses C.

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[1] *Loc. cit.*

The pentosan contents of various Javan defecation molasses, given in the Dutch papers quoted, have been recalculated to a per cent. Brix basis, assuming 86° Brix for the molasses, precipitation having been by acetic-acid-alcohol.

Table III.

Molasses.	Pentosan, per cent. Brix.
Sempalwadak	0·84
Kalimati	0·58
Tirto..	0·67
Langsee..	0·34
Tjoeki	0·27

These figures are of much the same order as those of Trinidad molasses recorded in Table I.

(B) The Removal of Pectin and Pentosan from Solution.

(1) *The Precipitation of Calcium Pectate from Alkaline Solution.*

This was studied in order to complete the experiments previously recorded on the precipitation of calcium pectate by calcium hydroxide.[1]

A pectin solution prepared from lime rind was used for the stock solution, which was preserved with toluene. An aliquot portion (A) was analysed for pectin, using the method of Haynes and Carré; other portions were treated with an excess of calcium hydroxide solution; in one case the solution (B) was made acid with acetic acid before boiling, while two other portions (C and D) were precipitated from boiling alkaline solution without the addition of any acetic acid. The results are tabulated below (the last column representing the pH of the solution from which the calcium pectate was precipitated).

Table IV.

Method of Precipitation.	Calcium Pectate precipitated, per cent. Solution.	Ash, per cent. Calcium Pectate.	pH of the Solution.
(A) Haynes-Carré..	0·103	10·8	4·4
(B) Saturated $Ca(OH)_2$, then acetic acid..	0·098	10·2	4·4
(C) Saturated $Ca(HO)_2$, no acid..	0·141	38·1	10·0
(D) Saturated $Ca(OH)_2$, no acid	0·153	40·3	10·0

Whereas approximately the same weights of precipitate were obtained in A and B, appreciably greater amounts were precipitated in C and D. Moreover, the precipitate from the alkaline solutions contained more ash, doubtless due to the presence of calcium carbonate, the result of boiling calcium hydroxide in the air. The filtrates from C and D were neutralized with acetic acid and treated for the Haynes-Carré method of pectin precipitation, but in neither case was any calcium pectate precipitated. One may conclude that the calcium hydroxide had thrown down all the pectin as calcium pectate, or rather had precipitated the same substance as is obtained in the Haynes-Carré method. The composition of calcium pectate has recently been questioned by Wichmann,[2] who states: "The calcium pectate may be a mixture of two compounds; if not, it certainly is an intermediate compound between pectin and pectic acid."

(2) *The Precipitation of Cane Juice Pectin by Calcium Hydroxide.*

500 c.c. of Bamboo cane containing a known amount of pectin (0·01 per cent. Brix) was boiled, and filtered through ordinary filter-paper on the Buchner funnel. The filtrate was analysed by the Haynes-Carré method, and found to contain the same amount of pectin as calcium pectate. (See A, in Table V.) To three other portions of 800 c.c. of the same juice were then added varying

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[1] *I.S.J.*, 1923, 635.

[2] *J. Assoc. Official Agric. Chem.*, 1923, 7, p. 107; *I.S.J.*, 1924, 112.

amounts of a suspension of calcium hydroxide of 4° Brix. The juices were boiled, filtered by suction through the Buchner funnel, and the filtrates analysed, the results being given below in Table V.

Table V.

	Calcium Hydroxide.	pH of the Filtered Juice.	Calcium Pectate, per cent. Brix Filtered Juice.
(A)	0·0 c.c. 4° Brix	5·3 acid to phenol phthalein	0·011
(B)	11·0 c.c. 4° Brix	8·9 alkaline	0 000
(C)	5·0 c.c. 4° Brix	8·3 neutral	0·000
(D)	16·0 c.c. saturated $Ca(OH)_2$ solution ..	6·7 acid..	0·090

No precipitate was formed in B and C after standing 24 hours; while in D practically all the pectin was recovered. This is in agreement with the observation made previously by the author[1] that no calcium pectate was precipitated unless the solution for some time reacted alkaline to bring about the conversion of pectin to pectic acid. In the experiment then described, the pectin solution was derived from cane fibre, from which all sugars had been removed by washing. The calcium pectate separated from juice is much more finely divided than the calcium pectate precipitated in the absence of sucrose and other constituents of juice, such as proteins, amino-acids and tannins, which exert a protective action towards other colloids. It is possible that under factory conditions where the clarified juice is at once concentrated to syrup, that the calcium pectate, when formed, may not be precipitated owing to the stabilizing effect of the protective substances mentioned.

Samples of Barbados syrup which were about a month old deposited a white precipitate. This was separated by decantation and washed free of sucrose, and its pentosan content found to be 11 per cent. on the oven-dry substance, much the same as the "pentosan" contents of the impure calcium pectate precipitates mentioned previously. The syrup precipitates noticed by COATES and SLATER,[2] BIRCKNER,[3] and BIRD[4] may have contained calcium pectate, though in the last two cases the organic matter was not examined, attention being concentrated on the mineral constituents. COATES and SLATER describe the precipitate as gelatinous, and containing a fairly constant quantity of a non-sugar.

(3) *The Effect of Calcium Hydroxide on the Pentosan of Cane Juice.*

Samples of juice crushed in a hand mill from the Trinidad seedling cane were preserved with mercuric chloride, 1 grm. per litre, their pentosan content determined in the manner described above in this paper, the juices being limed at the same time as the pentosan determination was made, as the amount of pentosan appears to increase on standing.

Then 500 c.c. portions of juice of known Brix were defecated by cold and by hot liming, i.e., adding the lime-cream either to the cold juice or to the boiling juice. In either cases the juices were boiled for 30 secs. and subsided for 30 mins. The Brix of the clarified juice was taken by determining the refractive index, and 400 c.c. were used for the pentosan determination. The pH of the raw and clarified juices was determined colorimetrically, and the results are given below.

This Table VI is somewhat incomplete, and the results appear inconclusive. With juice A and cold liming there is a reduction in the amount of pentosan, though hot liming seems to increase the pentosan. It will be noted that the hot limed juice had a higher pH., i.e., was more alkaline than the cold limed juice, although the same amount of 4° Brix lime-cream was used for each. In experiment B there is noted a slight reduction of pentosan in each case, though with the experimental error it is too small to be noted. Owing to lack of juice no hot liming was performed with juice C, and no cold liming with juice D. In C, which was an "alkaline clarification," the pentosan again increased, while with D, an "acid clarification," the pentosan remained the same.

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[1] *I.S.J.*, 1923, 635.

[2] *J. Ind. Eng. Chem.*, 1916, 8, 780.

[3] *La. Planter*, 1922, 68, 285.

[4] *Ibid.*, 1922, 69, 61.

Table VI.

				COLD LIMING.		HOT LIMING.	
Expt.	Juice examined.	pH Raw Juice.	Pentosan, per cent. Brix Raw Juice.	pH of the Clarified Juice.	Pentosan, per cent. Brix Clarified Juice.	pH of the Clarified Juice.	Pentosan, per cent. Brix Clarified Juice.
(A)	Trinidad seed	4·6	0·044	6·8	0·036	7·6	0·056
(B)	,,	4·6	0·049	7·0	0·046	6·9	0·045
(C)	,,	4·5	0·049	8·5	0·056	—	—
(D)	,,	4·5	0·065	—	—	6·4	0·065

Mercuric chloride could not precipitate the pectin from solution (*vide* FELLENBERG,[1]) but in any case the small amount of pentosan contained therein could not appreciably influence the results. Possibly owing to some decomposition of the hexose sugars in hot alkaline solution, a furfural-yielding complex is formed which would account for the increased amount of "pentosan." Or there might have been sufficient fibre in the juice (although strained through 100-mesh gauze) from which the free calcium hydroxide could dissolve xylan.

All that can be remarked of the above experiments is that neither in acid nor in alkaline clarification, by cold and by hot liming, is any appreciable amount of pentosan removed in the lime precipitate. In this connexion must be recorded the observation of HAZEWINKEL and STEUERWALD[2] that no pentosan was removed from the juice by defecation with lime, and that all the pentosan in the mixed mill juice could be recovered in the final molasses. No direct experiments, however, were made by treating juices with lime; the authors merely calculated from the juice and molasses figures. STEUERWALD and VAN DER LINDEN[3] found much less pentosan in carbonatation molasses than in defecation molasses.

It would appear, that in the carbonatation process the large initial excess of lime, and the subsequent formation of a copious granular precipitate of calcium carbonate, remove much pentosan from solution. In addition the pectin should be precipitated by calcium hydroxide as calcium pectate. The pentosan in carbonatation molasses, therefore, should consist of xylan and possibly a small part of araban, a constituent of pectin noted by EHRLICH[4] who found it in beet molasses, newly derived from the pectic substance present in beet pulp. EHRLICH states that this constituent, which amounts to 10 per cent. of the pectin, is not precipitated by lime during manufacture. The presence of araban in cane molasses has never been recorded, as far as we are aware, probably never having been looked for.

The difference in the hydrochloric and acetic-acid-alcohol precipitates in the defecation and carbonatation molasses is interesting. There is a much nearer agreement in the pentosan per cent. molasses figures in the case of the defecation than in the carbonatation molasses. This can be explained if we assume that there is as much, or more, pectin as pentosan in the defecation molasses, and that this pectin is removed during carbonatation. Now the pectin will be precipitated by both hydrochloric-acid-alcohol and acetic-acid-alcohol, whereas the pentosan (assumed to be chiefly xylan) will not be precipitated so completely by hydrochloric-acid-alcohol, as by acetic-acid-alcohol, according to HEUSER and BRADEN.[5] Hence in the carbonatation molasses from which it is assumed the principal constituent of the pectin is absent, it is not surprising to find these considerable differences in the pentosan precipitated by alcohol acidified either with hydrochloric or acetic acid.

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[1] *Mitt. Lebensm. Hyg.*, 1914, 5.

[2] *Loc. cit.*

[3] *Loc. cit.*

[4] *Chem. Zeit.*, 1917, 41, 197.

[5] *J. Pract., Chem.*, 1922, 104, 259.

For here we are concerned with the true pentosans, xylan and possibly araban, whereas in the defecation molasses there is present pectin as well as the pentosan.

STEUERWALD and VAN DER LINDEN[1] gave another explanation of this difference in the amount of furfural-yielding substance precipitated according to the acid-alcohol used. They assumed that the pentosan was associated with the lime salts of organic acids which are present in the acetic-acid-alcohol precipitate, but absent in the hydrochloric-acid-alcohol precipitate. There is an accumulation of these salts in the carbonatation molasses as shown by the great difference in the total alcohol precipitates. The pentosans may be adsorbed in the bulky alcohol precipitate in direct ratio to the precipitate. The authors moreover showed that furfural-yielding substance could be dissolved from the acetic-acid-alcohol precipitate from a defecation molasses by washing with 70 per cent. alcohol containing hydrochloric acid. In addition to the furfural-yielding substance, which amounted to about 33 per cent. of the total furfural in the precipitate, the lime salts were dissolved, and these could be precipitated by neutralizing the acid-alcohol solution. However this second precipitate gave no furfural, and the authors concluded that part of the pentosan in the acetic-acid-alcohol precipitate was merely adsorbed.

The explanations of both the Dutch workers and the writer are of the nature of surmise. It is very necessary to devise further experiments to show exactly in what form the pectin and pentosan are present in different molasses, and it will be interesting to study the effect of sulphitation, and carbonatation, as well as activated carbon on these colloid substances.

Clarification in Raw Sugar Factories.[2]

By MANUEL L. ROXAS and ANGEL A. AFRICA,
Of the College of Agriculture, P. I.

In the manufacture of raw cane sugar, the general process of clarification consists simply in adding to the juice the amount of lime found best by experience, heating the juice to the boiling point, and subsiding the mud in settling tanks or eliminators.

Different authorities seem to have expressed different opinions on the matter of final reaction to be obtained in liming. DEERR,[3] the well known authority on sugar, concluded from his experiments that a juice acidity of 0·25 to 0·5 c.c. appears to fulfil the conditions demanded by a good defecation. Deerr's experiments consisted in treating juice with milk-of-lime to various decreasing acidities and noting the rate of settling, volume of mud, method of separation of the precipitate, and clearness of supernatent liquid. According to BREWSTER and RAINES[4] his acidities correspond to about 6·8 to 7·0 pH.

Coming from such a recognized authority in the sugar world as DEERR, these results have apparently been accepted at their face value, and no attempts have been made to determine their general applicability under different conditions. Deerr's communication resulted from a limited number of samples and under necessarily very limited sets of conditions. We have every reason to believe that the acidity to be left in the juice for proper defecation will depend on a number of factors, such as soil, age and variety of cane, and condition at the time it is milled.

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[1] *Loc. cit.*

[2] Abridged from a Paper presented to the First Annual Convention of the Philippine Sugar Association, Manila, P. I., 1923.

[3] "Cane Sugar," 2nd Edition, p. 271 ; also *I.S.J.*, 1920, 618.

[4] *I.S.J.*, 1923, 92.

HOT OR COLD LIMING.

Recent contributions seem to indicate that heating the juice to the boiling point and then liming afterwards produce better results than the present practice, e.g., MAURICE BIRD[1] on the factory scale, and KREULEN[2] in laboratory tests.

DEERR himself in the experiments already cited observed that "if the juice after the heating with alkali was actually boiled and the precipitate broken up, a slow subsidence occurred and the results were irregular." He boiled juice before treatment with alkali much as KREULEN did. Then, while still at the boiling point, the alkali was added, and he obtained better results.

EXPERIMENTAL.

The purpose of the present paper is to report on the preliminary results obtained with the use of Deerr's method in determining the proper reaction for liming in defecation in raw sugar manufacture, and to offer suggestions for further investigations of the subject in its application on a factory scale.

Deerr's method consisted in titrating the juice for total acidity; placing 10 c.c. portions of fresh samples in a series of test-tubes, and adding to each a gradually increasing volume of clear lime-water, then boiling and allowing to settle for 15 minutes. Comparison of the different test-tubes indicated the brightest supernatent liquid. Such a test-tube was marked and its residual acidity noted. By residual acidity, is meant the difference between the calculated number of c.c. of N/10 alkali required for neutralization to phenolphthalein, and the number of the same solution added to each test-tube. The results are given in Table I.

TABLE I.

Acidity and Alkalinity of Cane Juices used in the Experiment that produced the brightest Clarified Juice, using Phenolphthalein as Indicator.[3]

Unit No.	Total acidity of Raw Juice in terms of c.c. Normal Acid, per 100 c.c. Juice.	Acidity of brightest Clarified Juice on the acid side in terms of c c. Normal Acid, per 100 c c. Juice	Alkalinity of brightest Clarified Juice in c.c. Normal Alkali, per 100 c.c. Juice.
1	2·21	0·13	0·75
2	2·90	0·11	0·29
3	2·32	0·25	0·63
4	2·32	0·01	0·87
5	2·32	0·27	0·49
6	2·21	0·33	0·53
7	2·21	0·16	0·70
8	2·44	0·48	0·64
9	3·02	0·12	0·40
10	2·55	0 25	0 13
11	2·21	0·15	0·45
12	2·44	0·35	0·38
13	2·56	0·07	0·76
14	2·90	0·09	0·49
15	1·28	0·20	0·46
16	1·39	0·06	0·76
17	1·74	0·17	0·49
18	1·97	0·07	0·76
19	1·51	0·10	0·73
20	1·51	0·12	0·63
Average	2·09	0·19	0·55

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[1] *La Planter*, 1921, 49, 61. [2] *I.S.J.*, 1923, 265.

[3] Only 20 of the 50 tests made are here reproduced. The average figure stated is for the 50 tests.

In another set of experiments, after determining the acidity, increasing amounts of clear lime-water were calculated for 100 c.c. of juice so as to produce an acidity gradually decreasing by 2 c.c. of the lime-water to 100 c.c. juice. Such amounts were added to the juice contained in a series of beakers; the juice brought to boiling, allowed to settle, the clearest juice marked and filtered, and the purities determined. Part of the results is given in Table II. Table III gives results[1] obtained with the same juice, by liming them to residual acidities close to 0·2 c.c. Normal per 100 c.c. juice. In order to express the acidities in terms of pH values, the latter were calculated using the approximate formula given by CLARK.[2]

TABLE II.

Reactions of brightest Clarified Juice, showing increases in Purity over Raw Juice.

		BRIGHTEST JUICE.						
		ACID SIDE.		ALKALINE SIDE.			INCREASE IN PURITY.	
Juice. No.	Total Acidity of Juice.	c.c. Normal, per 100 c.c. Juice.	Apparent Purity.	c.c. Normal per 100 c.c. Juice.	Apparent Purity.	Purity of Raw Juice.	Acid.	Alk.
1	1·28	3·03 pH = 6·36	89·85	0·24 pH = 11·38	90·65	89·19	0·66	1·46
2	1·63	0·11 pH = 5·87	86·47	0 27 pH = 11·43	89·81	86·67	0·20	3·14
3	1·51	0·13 pH = 5·77	83·61	0·15 pH = 11·18	87·18	83·20	0·41	3·98
4	1·28	0·17 pH = 5·55	83·58	0·10 pH = 11·00	82·07	79·03	4·55	3·04
5	1·74	0·03 pH = 6·50	80·80	0·12 pH = 11·08	81·42	74·71	6·09	6·71
6	1·74	0·17 pH = 5·70	73·50	0·12 pH = 11·08	73·14	68·38	5·12	4·76
Ave. of 17 tests		0·18 pH = 5·98		0·27 pH = 11·36			2·96	3·57

TABLE III.

Results obtained when the same Juices used in Table II were Limed to a Residual Acidity about O. 2 c.c. N. per 100 c.c. Juice.

Exp. No.	Total Acidity, Normal, per 100 c.c	Acidity of Clarified Juice.	Purity of Clarifier Juice.	Purity of Raw Juice.	Increase in Purity.	Remarks.
2	1·63	0·24 pH = 5·47	86·67	86·66	+ 0·01	Still turbid
3	1·39	0·15 pH = 5·66	87·79	85·70	+ 2·09	Still turbid
4	1·51	0 13 pH = 5·77	83·61	83·20	+ 0·41	Brightest
5	1·28	0·17 pH = 5·55	83·58	79·03	+ 4·55	Brightest
6	1·74	0·31 pH = 5·40	82·07	74·71	+ 7·36	Still turbid
7	1·74	0·17 pH = 5·70	73·50	68·37	+ 5·13	Brightest
Ave. of 17 tests		0·20 pH = 5·82			+ 3·196	

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[1] Only six of 17 tests made are here reproduced.

[2] "The Determination of Hydrogen Ions" (Williams & Wilkins Co., Baltimore, U.S.A.).

DISCUSSION OF THE RESULTS.

In order to have a clearer impression of the results obtained in the present experiments, we give below a few of those obtained by DEERR in his well-known experiments already cited. In one he obtained the following results for three selected acidities, rearranged by us to make the discussion clearer:—

TABLE IV.

Data calculated from Deerr's Experiments.

Acidity, c.c. Normal, per 100 c.c. Juice.	pH.	Depth of column of clear Supernatant Liquid. Total depth of liquid, 4⅜ in.		Volume of ppt. after 1 hour.	2 hours.	12 hours.
0·08	4·74	3⅜ in.	3⅜ in.	3·0	2·6	2·2
0·2	5·59	⅛ in.	$\frac{3}{16}$ in.	12·4	10·1	7·3
Neutral	9·00	Settling had not begun		13·3	10·8	7·8

Table IV shows decided differences in the depth of column of supernatant liquid and that of mud, depending on the acidity left in the juice. The results also indicate that a greater volume of precipitate comes out from the juice as the acidity is reduced towards neutrality, and that for very narrow differences in residual acidity great differences corresponds in the volume of precipitate. DEERR had not pursued his work far enough to show what would have happened if the juice had been limed beyond the phenophthalein neutral point.

Table V is taken from other experiments of DEERR given in the same paper, showing the volume of precipitate under conditions where settling was more rapid than in the foregoing.

TABLE V.

Further Data calculated from Deerr's Experiments.

Acidity, c c. Normal, per 100 Juice.	pH, calculated by approximate formula.	Time in minutes.	Vol. of ppt. in c.c.	
0·70	5·03	4·0	3·0	2·2
0·35	5·40	4·6	3·6	2·6
Neutral	9·00	5·4	4·0	2·9

In these results it can also be seen that decided differences in the volume of the precipitate are observed, depending on the reaction of the juice after clarification.

In our own experiments, the results of which are shown in Tables I, II and III, we extended the addition of lime-water well beyond the phenophthalein neutral point. We have observed the very interesting phenomenon that the clarity of the juice increases upon the addition of alkali up to a certain hydrogen-ion concentration below the natural point. Beyond this concentration the juice becomes turbid up to a certain alkaline point, when the juice becomes clear again, although with a deeper colour. The further addition of alkali would no longer cause any change. Thus, in our experiments we have been able to mark a point of maximum clarity on the acid side and one on the alkaline side, both of which points are given in Table II. Table III shows that optimum clarification cannot be obtained when all juices are limed to approximately a constant residual acidity. Under these conditions some raw juices will produce clear supernatant liquid, others will still be turbid.

ACIDITY AND CLARITY WHEN LIMING BELOW NEUTRALITY.

DEERR found 0·25 to 0·5 c.c. residual acidity in terms of normal per 100 c.c. juice to fulfil the conditions demanded by a good defecation. In our experiments we have found the range wider, lying between 0·01 c.c. to 0·58 c.c. normal per 100 c.c. juice (Table I). The corresponding pH values for Deerr's figures, according to BREWSTER and RAINES,[1] were 6·8 to 7. We do not know whether figures were obtained by actual potentiometer measurement. By calculating our figures by means of the approximate formula just referred to, and allowing that the dissociation constants of the acids present in the juice would have an average equal that of acetic acid, the pH values corresponding to our figures are between 5·22 and 6·50. These figures are only tentative and should be verified by actual potentiometer measurement using a still greater number of juice samples.

INCREASES IN PURITY AND CLARIFICATION.

Table II shows increases in purity when juices are clarified to the brightest points both on the acid and alkaline sides. Comparison of these purities indicates that alkaline defecation to the point of maximum clarity causes a greater increase in purity: 3·57 per cent. as against an average of 2·96 for the acid defecation. Whether these increases are real or apparent, it is hard to tell until we have repeated the experiment using the double polarization instead of the single polarization method. For in order that the juices may become bright on the alkaline side, they had to be strongly limed, and such excess of alkali together with the high temperature to which the juices were heated may have caused destruction of levulose, resulting in increases in direct polarization. These increases are larger than the average obtained in practice which is very seldom above 2, and point to the possibility of raising the practical limit of increase of purity of syrup above that of raw juice by a very close control of defecation.

FACTORY CONTROL OF LIMING.

The results also confirm the good effect reported from a number of factories in Hawaii on the increase in polarization due to a more alkaline defecation.[2] Since the dangers of an alkaline defecation are well-known, it is doubtful whether the greater increase due to the use of a greater amount of lime to a point where it will produce maximum clarity on the alkaline side would be of advantage, as it may in the long run be upset by the destruction of invert sugar and of sucrose in the subsequent boiling of the juice and of the molasses. However, if close control of liming could be carried out, the results suggest that a good effect could be had if the juice is limed to the brightest point on the alkaline side and after settling neutralized by the use of phosphoric acid or sulphur dioxide and resettled. Whether this procedure will pay in a raw sugar factory or not, actual test on a commercial scale can only determine for each factory.

The residual acidity left after liming to brightest juice on the acid side is still great, relatively speaking, and when the juice is concentrated to syrup and to massecuite may attain such a concentration as to cause inversion of large amounts of sucrose. We have found in the literature very little data on this particular point.

The results of our experiments show that the range of acidity that will cause proper clarification is, relatively speaking, wider than it was supposed to be. Evidently the proper way to fix the right amount of lime to add in defecation is to determine it for every tankful of juice before liming. Aside from the difficulty in fixing the right pH value within the limits necessary to bring about maximum precipitation and clarity, when a highly coloured juice has to be dealt with, for instance, juices of the Negros purple variety, there is the added difficulty that the method is also a trial-and-error one, and men will soon get tired of it and forget to adjust the lime to proper reaction for every tankful of juice, letting the liming of some juices go at the last one determined. Moreover, optimum clarification does not seem to take place at any definite pH value within certain limits.

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[1] *I.S.J.*, 1923. 88.

[2] *I.S.J.*, 1923, 204, 548, 604.

The best solution to the problem would be the design of an apparatus that will determine the right reaction-point for optimum defecation, automatically correlate this amount to the amount of lime to be added to the tankful of juice, and automically add the lime, the whole operation not taking more than 5 min. We have timed the charging and discharging of a double tank Howe scale in a big Philippine factory and have found the two operations to last 15 min. If the operation of determining and adding the amount of lime needed for a tankful could be done in 5 min., or less, there will be ample time for the operator to attend to the measurement of the lime to be added and to the charging and discharging of the juice scales as well.

It would not do, of course, to use the ordinary intermittent method of settling, as the juices will necessarily be mixed with consequent change in the pH values, and since the colloids of the cane juice are reversible towards the hydrogen ion concentration, the change in reaction may reverse the conditions of the precipitate and turbidity will result. A continuous settler as in the Dorr clarifier system would be necessary.

SUMMARY OF CONCLUSIONS.

1. The end reaction to be attained, or residual acidity to be left, in liming different juices varies according to the nature of the cane, and does not seem to have fixed pH values.

2. When the lime is added to cold juices in gradually increasing amounts, and they are brought to boiling, then allowed to settle, two points of maximum clarity are obtained. One on the acid side of neutrality (pH=7) and the other on the alkaline side. The acidities producing brightest juice on the acid side lie, for the juices studied, within residual acidities ranging between 0·01 and 0·58 c.c. normal per 100 c.c. juice referred to phenolphthalein neutral point. When these acidities are expressed in pH values calculated with the aid of an approximate formula, the acidities correspond to figures ranging between 5·22 and 6·50. The pH values for optimum clarity on the alkaline side lie between 11 and 12.

3. For close control of liming in a factory where the nature of the juice varies for every tankful, it is desirable to determine the right reaction to lime for every tankful of juice. When liming is thus controlled, continuous clarifiers or settling tanks will have to be used.

4. For the most satisfactory way of controlling the liming of juices in a raw sugar factory, it is very desirable that an automatic or semi-automatic apparatus be devised that will determine the right defecation point, and at the same time correlate such a point with the accurate amount of lime to be added to the tankful of juice and automatically add such amount, the whole operation requiring a few minutes. The senior author has been working on the design of such an apparatus, and will report on the results obtained in the very near future.

5. It is recommended that the use of a self-recording potentiometer be experimented with to find out whether it can be used with raw and clarified juices.

It is stated that a syndicate in Java, of which the managing director is Mr. E. HELFFRICH, is considering plans for the erection of another sugar factory, south of Djocja.

Russia's Sugar Campaign of 1923-24.[1]

The results of Russia's sugar campaign of 1923-24 exceeded expectations in regard to both the sugar beet crop and the yield of sugar. Instead of the anticipated 11,600,000 berkovetz (1 sugar beet berkovetz = 12 poods, or 433 lbs.) of beets, the factories have actually received 13,270,000 berkovetz, or 14·4 per cent. in excess of the programme. The average yield of beets per dessiatine (2·7 acres) was 59·9 berkovetz (4·3 long tons per acre), ranging from 50·6 berkovetz in the Province of Kursk to 65·7 in eastern Ukraine.

The total area under beet cultivation in 1923 amounted to 222,215 dessiatines (600,000 acres), out of a total area of 1,113,000 dessiatines of land nationalized for the sugar industry. The area of land planted to beets directly by the sugar factories amounted to between 18,000 and 19,000 dessiatines, or 2 per cent. of the entire nationalized beet sugar acreage and 8·6 per cent. of the entire area under beet cultivation in 1923. The rest of 205,000 dessiatines was cultivated by private growers.

The output of sugar in the 110 factories operated by the State in the campaign of 1923-24, in the terms of the white granulated product, amounted to 21,500,000 poods (346,776 long tons), which compares with 12,215,055 poods produced in 1922-23 by 112 factories. Production of 10 factories leased from the State by private parties amounted to 1,238,044 poods, against 368,859 poods produced in 1922-23 by seven leased factories. The entire output totalled 22,738,000 poods (336,742 tons), against a total of 203,000 tons in 1922-23.

The following table shows the operations and results of the Russian beet sugar campaign of 1923-24, as compared with the last pre-war year, 1913-14, exclusive of former Russian Poland :—

		1913-14.	1923-24.	Per cent. of 1923 to 1913.
Area sown to beets	acres	1,791,000	600,000	33·5
Yield of beets	long tons	12,132,900	2,566,387	21·2
Yield of beets per acre	do.	6·77	4·28	63
Number of factories in operation		265	120	45·3
Quantity of beets worked up	long tons	12,031,662	2,517,806	21
Total yield of sugar	do.	1,488,758	366,742	24
Percentage of extracted sugar to weight of beets.		12·21	14·5	120

Jugo-Slavia.

(Department of Overseas Trade Report.)

A great deal is being done to encourage the cultivation of sugar beet in Jugoslavia, and the area sown with this crop has shown a steady increase since 1920, when it amounted to 15,000 hectares, while in 1923 24,000 hectares were planted. About 30,000 tons of sugar were manufactured in 1923. The capacity of the Jugoslav sugar factories is about 100,000 to 120,000 tons per annum. Home consumption absorbing 60,000 tons, it would be possible, working at full capacity, to export 50,000 to 60,000 tons yearly.

Conferences have been held at which measures to be taken in order to increase the production of sugar beet were discussed, and the following resolution was made :—

That a consultative commission of representatives of the growers and manufacturers should be appointed at the Ministry of Agriculture and Waters which would control culture, manufacture, and prices. It was decided to encourage, by privileges given to the agricultural co-operatives, the growing of beet by the peasants. As concerns large estates, the view was that the proprietors should undertake to cultivate beet on that part of their land left to them above the maximum allowed by the Agrarian Reform Law.

The conference demanded the increase of the customs duty on sugar by 2 dinars[2] per kilogram; the granting of a delay of three months to the factories for the payment of the consumption tax; and the construction of special lines for bringing the beetroot to the factories.

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[1] Abstracted from *Trade and Industry Gazette*, Moscow, by *Commerce Reports*, Washington.

[2] The *dinar* equals the franc at par or 9½d.

Czecho-Slovakia.

The 1924 Sugar Output.

According to reports from Prague received by the Department of Overseas Trade, the Czecho-Slovak Government has fixed the quantity of sugar to be operated this year by the sugar refineries in that country at 94,670 metric tons, while the mixed factories—that is, those turning out white sugar as well as raws—are allotted 186,930 metric tons, both figures being in terms of refined. The raw sugar factories will of course supply the their material, amounting to 107,924 metric tons of raws.

The *Central European Observer* of 26th July stated that prospects of a good sugar beet yield continue satisfactory and the following estimate is made in trade quarters of the output of sugar in the coming season. The figures for the past two seasons are given for the purpose of comparison :—

	1924-25	1923-24	1922-23
	(Estimate)	(Actual Yield)	
		(In Tons of Raw Sugar).	
Bohemia	675,000	527,209	425,146
Moravia	475,000	335,354	234,469
Silesia	15,000	13,432	10,593
Slovakia	185,000	124,005	74,240
	1,350,000	1,000,000	744,448

American Commerce Reports.[1]

THE DANISH SUGAR INDUSTRY.

Denmark has, according to official estimates, nearly trebled its consumption of sugar during the past 30 years, so that at the present time the total annual consumption is approximately 150,000 metric tons compared with 47,000 metric tons prior to 1890. The per capita consumption during 1923 was approximately 41·4 kg. of refined sugar [91 lbs.].

The Danish demand for sugar, which during recent years has been supplied chiefly if not entirely through domestic production, during 1923 was supplied to an increasing extent through importation. Sugar exports were unimportant during 1923 ; imports amounted to about 63,000 metric tons, compared with about 20,000 tons in 1922 and a pre-war average of 14,000 tons.

There were nine sugar factories and three refineries operating in Denmark in the season just completed, and the sugar industry appears to be in a very satisfactory condition. "Danish Sugar Factories," an association which controls practically the entire sugar production, declared a dividend of 25 per cent., which is the highest dividend ever paid by this association. Sugar production amounted to 103,900 metric tons, compared with 85,400 tons in the previous year. The increased production is attributed to the increased acreage planted to sugar beets in 1923.

SWEDEN.

A new agreement between the two Swedish sugar trusts and the various associations of beet growers in Sweden was brought to a successful conclusion on April 28th, 1924, as the result of negotiations in progress since the middle of December, 1923. The new agreement is valid for the three beet-growing seasons of 1924, 1925, and 1926, and can be cancelled by either party, subject to the approval of the Government committee, should the price of sugar fall so low as to make the enterprise unprofitable, if the cost of labour should rise too high, or if any other particularly unfavourable economic condition should arise.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

The trusts will supply seed to farmers free of charge, guaranteeing a germinating capacity of 75 per cent. The trusts have further agreed to keep all their mills running, if contracts come up to at least 80 per cent. of the 1923 acreage.

Publications Received.

Sugar in Relation to the Tariff. By Philip G. Wright. Crown 8vo., 312 pages (The McGraw-Hill Book Co., Inc , 370 Seventh Avenue, New York: McGraw-Hill Publishing Co. Ltd., Bouverie St., London, E.C.4.) 12s. 6d. net.

This volume, issued by the Institute of Economics of the Carnegie Corporation of New York, professes to be a dispassionate study of one of the most highly controversial matters in the United States, the effect of the tariff on the price of sugar. It aims at investigating the problem from the point of view of the public welfare as contrasted with that of private business interests. In the introduction it is pointed out that "the great sea-board refineries and the American investors in Cuban sugar properties have a tariff interest diametrically opposed to that of the domestic cane and beet sugar producers. Both parties have a very direct pecuniary interest in the tariff and both are in a position to employ the best legal and literary talent in impressing Congress and the general public with their views. Hence it follows that most of the articles that appear in regard to sugar in its relation to the tariff are of the nature of attorneys' briefs for their clients. It is for the interest of the seaboard refineries and the American investors in Cuban properties, since they would be pecuniarily benefited by a decrease in the rate of duty, to attribute the high price of sugar in the spring of 1923 to the tariff and thereby arouse public indignation against the high rates of duty recently enacted. It is for the interest of the domestic cane and beet sugar producers, since they are pecuniarily benefited by the high rates of duty of the Acts of 1921 and 1922, to divert public scrutiny from the tariff by arousing indignation against New York speculators." So as between these two parties, the Institute of Economics desired to investigate the subject impartially and arrive at some measure of truth.

This work being written for students of economics contains a good deal of general information on the sugar industry, its character, growth and importance, and then goes on to deal with the history and incidence of the U.S. tariff. The final conclusion the author draws after weighing all the arguments and facts is that from the standpoint both of revenue and protection sugar is a suitable commodity to be subject to a moderate rate of duty. A rate which will maintain roughly the present proportions of domestic and foreign sugars in the domestic market is to be recommended. From the best data now available the author concludes that a rate of from 1·25 to 1·5 cents per lb. on 96° Cuban centrifugals is about adequate to accomplish this purpose. Those interested in studying in detail his data and the conclusions reached are referred to the book for further information.

Clouds and Smokes: The Properties of Disperse Systems in Gases and their Practical Applications. By Wm. E. Gibbs; with foreword by Sir Oliver Lodge. (P. Blakiston's Son & Co., Philadelphia, U.S.A.). 1924. Price: $3·00.

This book is of interest to the sugar refiner by reason of its treatment of the theory of dust explosions, due to the formation of aerosols, a subject which has been developed by BEYERSDORFER[1] among others.

Among new companies recently registered are: Humophos Fertilizers, Ltd., of Slaithwaite, Yorkshire; manufacturers of bacteria for manures; capital £1000 in 1000 shares of £1 each.

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[1] *I.S.J.*, 1923, 363, 412, 551.

Correspondence.

SUBSTANCES INHIBITING INVERSION OF SUCROSE IN MOLASSES.

To the Editor, "The International Sugar Journal."

Sir,—On page 335 of your June number appeared an abstract of an article by A. H. **Erdenbrecker** on the effect of certain non-sugar substances in inhibiting the inversion of the sucrose present in beet molasses. It was stated that the same quantity of sulphuric acid had been used for the inversion of a pure solution of sucrose as for a beet first molasses, but that the sucrose in the former was much more completely inverted than that present in the latter, conditions such as time and temperature being alike in both experiments. This difference is ascribed to the presence of organic impurities in the molasses, which, it is stated, "would be of some theoretical interest to isolate and study."

But the difference in the result described would appear chiefly to be due to the fact that in the case of the molasses, part, or all of the sulphuric acid had combined with the bases of the organic salts, thus liberating the organic acids; so that actually the result was a comparison between the inverting effect of a certain amount of sulphuric acid on the one hand, and that of a mixture consisting of a smaller quantity of free sulphuric acid (or possibly none at all) and an unknown quantity of organic acids and other substances. A perusal of the original article confirms the statement of the abstractor that the amount of acid added was alike in both cases, the acidity of the acidified solutions being expressed in both cases as equal to N/10 sulphuric acid; whilst no indication is given that in the case of the molasses the precaution first had been taken to saturate the bases of the salts with sulphuric acid before adding the quantity used for the inversion of the pure sugar solution.

Yours faithfully,

Charles Ferguson, F.C.S.,
Sugar Consultant.

19, Craven Street,
London, W.C. 2,
July 26th, 1924.

⁂ Owing to the lack of data given by this German experimenter, it is not possible to conclude whether (as Mr. **Ferguson** suggests) the retarding effect under observation was due to the total or partial neutralization of the acid added for hydrolysis, or whether (as **Erdenbrecker** believes he has demonstrated) it was due to the presence of impurities having a "poisoning effect in chemical reactions." A calculation made with the assumption of different density and ash values indicates that probably the acid available for hydrolysis in Erdenbrecker's experiments was partially neutralized. At any rate, he appears not to be familiar with the literature of the question he has set out to study, because the substances which "would be of some theoretical interest to isolate and study" are in fact well known, namely certain amino-acids and their amides, which are capable of retarding the hydrolysis of sucrose by acids to a marked extent, as **Andrlik** and **Stanek**,[1] and later **Van Ligten**,[2] have shewn. Moreover, his work, which appears to have been suggested by the recently published studies by A. **Siebert** and P. **Lueg**[3] on the retarding effect of certain substances on chemical reactions, e.g., the solution of metals in acids, is open to criticism on other grounds.

Almost all the Russian factories operate carbonatation as a 3-stage process, adding 2 per cent. of CaO (in the form of milk) at the first, and 0·5 per cent. at the second, the third being worked without lime to reduce the alkalinity to the required degree. Two well-known technologists, J. E. **Duschski** and J. B. **Mintz**[4] now demonstrate as the result of numerous experiments extending over a reasonable portion of the season that two saturations only suffice, the same average result having been obtained with two as with three, in respect both of the purity coefficient and the colour.

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[1] *Zeitsch. Zuckerind. Böhm.*, 1906, 31, 417; *I.S.J.*, 1911, 149. [2] *Archief*, 1922, 30, 216-221; *I.S.J.*, 1922, 439.
[3] *Zeitsch. anorg. Chem.*, 1923, 193. [4] *Centr. Zuckerind.*, 1924, 32, No. 18, 241.

Brevities.

It is stated that beet carbonation scums are now being utilized in France for the production of a very satisfactory cement.[1]

Carnegie Refinery, Göteborg, Sweden, has installed high pressure boilers working at 100 atmospheres, after having experimentally obtained satisfactory results with a plant operating at 60 atmospheres.[2]

For the 12 months ending March last the exports of sugar from Canada totalled 57,860 short tons. Seven refineries are now at work, two in Ontario, two in Quebec, and one each in New Brunswick, Nova Scotia, and British Columbia.

Plans are being formulated by the Celotex Company for extending its process of making "insulate board" from bagasse to Cuba, the Philippines, and Australia. Since its erection, the parent plant at Westwego, U.S.A., has been enlarged several times, and at present produces over 250,000 ft. of this material daily.

On Ewa plantation, of Oahu, T. H., a field of cane yielded 16·68 tons of sugar to the acre.[3] The Hawaiian Commercial & Sugar Co. finished with an output of 63,000 tons of raw sugar for the 1924 season, the largest crop harvested by any single plantation in Hawaii, while their yield of 9·62 tons of sugar per acre is also believed to form a working record for the Territory.

During 1922-23 the quantity of *gur* melted by the refineries in India was 93,920 tons and the production of refined sugar was 50,670 tons.[4] If the production of factories making direct consumption be included, this figure is raised for the year stated to 74,050 tons. In Northern India the recovery of refined was 52·75 per cent. of the raw material, and in the Southern portion of the Empire, 57·5 per cent. for the same period.

A plough capable of opening up cane furrows on wet cane soil has been the object of several inventors during a number of years past. C. E. van der Zijl[5] states that in Java very promising trials were recently obtained with the van Dijk plough, which runs on sleds instead of wheels. In these trials the plough mentioned opened two trenches 20 × 18·5 in. of very wet clay soil at the rate of 32 metres per min., the tractive force required being 3000 kg.

In the recently published life of Linnæus by B. D. J. Witherby, it is stated that it was this great Swedish naturalist who first used the Centigrade scale, since in his *Hortus Clifortianus* (Holland, 1738) he published an illustration of a thermometer with 0° as the freezing and 100° as the boiling point. Celsius, also a Swede, whose name is identified with the Centigrade scale as its originator, proposed its adoption in 1742, but he appears to have suggested that 100° should be the freezing and 0° the boiling point.

Beetroot distilleries in France are hard hit by the considerable fall in the price of spirit compared with that of sugar. Since *le sucre est roi*, it is proposed by M. Vasseux[6] as a means of preventing the closing down of many alcohol plants that these should be used as juice extracting units, the sugar in the juice being converted to saccharate, and this sent to sugar factories proper, there to be decomposed in the carbonatation tanks. In the case of necessity, the saccharate might be dried, allowed to accumulate, and worked up after the termination of the ordinary campaign.

In a useful article on the practice of thermo-compression in the evaporation of liquids, R. Hoblzlt[7] points out that plunger pumps have an insufficient capacity for the purpose when applied to the multiple effect apparatus of the sugar factory. Both turbo and steam injector compressors offer better possibilities, though neither show any economy of steam when the power for compression is provided by a steam engine. In districts where cheap water-power is available, both would be of great interest, since their installation would enable the steam consumption factor greatly to be decreased, the second apparatus named being the preferable on account of its simpler operation.

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[1] *Rev. Gen. Chim. Appl.*, **25**.

[2] *Deut. Zuckerind.*, 1924, **49**, 373-374.

[3] *Facts about Sugar*, 1924, **19**, No. 1, 2.

[4] *Indian Trade Jonrnal*, 1924, **73**, 67-68.

[5] *Archief*, 1924, **32**, 306-311.

[6] *Bull. Assoc. Chim. Sucr. Dist.*, 1924, No. 11, 259-462.

[7] *Deut. Zuckerind.*, 1924, **49**, 678-680.

Review of Current Technical Literature.[1]

COST OF FILTRATION EQUIPMENT AND OPERATION: A COMPARISON OF THE THREE PRINCIPAL TYPES OF FILTERS. *W. G. Whitman and Tyler Fuwa.*[2] *Chemical and Metallurgical Engineering, 1924, 30, No. 9, 355-359.*

This is a useful paper, in that it describes a method of estimating the cost of filtration using the plate-and-frame, pressure leaf, and rotary vacuum types; and presents other data which have been collected with the co-operation of manufacturers of such equipment. In the first part of the paper is summarized a general opinion on the suitability of different filters for certain kinds of work, factors that influence the value of the filtration process as well as its costs being discussed, but as this information is known to engineers concerned with the subject it is unnecessary to reproduce it here. In the second section, however, is presented the average initial investment charges (for the U.S.A.) for apparatus of different types and sizes, and by way of general examples the following figures are given. In the case of the filter-press, two each 24 in. square, each having 30 chambers, with 1 in. frames, a filtering area of 211 sq. ft., and a total effective volume of 8·79 cub. ft., are taken as examples, the slurry being a precipitated metallic salt. In that of the pressure leaf filter, it is a battery of 9, each having a net filtering area of 1040 sq. ft., the slurry being mud (sp. gr. 1·27) from sugar liquor; while in that of the continuous vacuum filter it is an apparatus having a net filtering area of 600 sq. ft , the slurry being calcium carbonate.

SUMMARY OF DAILY COSTS OF TYPES OF FILTRATION EQUIPMENT.

	Filter-Press.		Pressure Leaf Filter.		Continuous Vacuum Apparatus.	
	$	Per cent.	$	Per cent.	$	Per cent.
(1) Investment	0·43	3·5	20·44	13·3	2·22	9·7
(2) Depreciation	0·73	6·0	34·07	22·3	3·70	16·1
(3) Power	0·17	1·4	22·50	14·7	7·20	31·3
(4) Labour	8·00	65·8	54·00	32·0	6·00	26·1
(5) Maintenance and supplies	2·82	23·3	27·37	17·7	3·85	16·0
Total daily cost .. =	$12·15	100·0	$158·38	100·0	$22·97	100·0
Cost per ton of solids =	$\frac{12{\cdot}15}{2{\cdot}81} = \$4{\cdot}32$		$\frac{158{\cdot}38}{500} = \$0{\cdot}31$		$\frac{22{\cdot}97}{200} = \$0{\cdot}11$	

By way of comment on these figures, it is remarked in regard to the filter-press equipment that labour and filter-cloth constitute the greater part of its operating costs, being almost 90 per cent. of the whole. In regard to the pressure leaf apparatus, the conclusion is that labour costs are considerably less in contrast with filter-presses, but that when kieselguhr as a filter-aid is necessary the charge due to it becomes a very prominent item. If about three tons of this material were used per run of 167,000 gallons of liquor, this is a daily charge at $50 a ton of $150, which when added to the stated costs for this apparatus, becomes $308·38, or $0·61 per ton. Lastly, in regard to the continuous vacuum apparatus, it is seen that power and fixed charges are relatively important items, meaning that this type is best adapted to 24-hour operation.

THE "J. R." CLARIFICATION AND DECOLORIZATION PROCESS FOR THE MANUFACTURE OF DIRECT CONSUMPTION WHITE SUGAR.[3] *J. J. Ragg.*[4] *Communicated to this Journal.*

To the mill juice is added finely powdered lime at the rate of about 80 grains (5·12 grms.) per gall., that is sufficient to make a saturated solution, the liquid being agitated in a suitable vessel by mechanical means, after which freshly prepared lime-water (a saturated solution containing 80 grains per gall. of CaO) is gradually run in until the density of the mixture is reduced to 1040 (about 6°Bé.). After subsiding, the clarified juice is passed to the heaters, then filtered into the decolorizing vessel, where, by being agitated by suitable mechanical means, animal charcoal (boneblack) between 30 and 60 mesh is added in sufficient quantity to completely decolorize after 10–15 minutes' mixing. Following this, the juice is run through a filter dressed with a layer of cotton wool and a layer of coarse grained animal carbon next to the cloth, all the coarser particles of carbon being thus separated; then it goes through funnel-shaped filter bags on the interior of which light magnesia has been deposited. After the clear juice has been evaporated to a syrup of about 30°Bé , a second filtration may be necessary to remove precipitated calcium and magnesium salts, boiling to grain in the usual way being the next stage. A very fine grade of white sugar is thus produced with a high yield, while the molasses, which is a good colour and flavour, may be sold as table syrup. In regard to the revivification of the carbon, this is done by alkaline treatment, using lye prepared from the bagasse ashes, and washing with water, acetic acid, and water again, being submitted to re-burning treatment after five or six of the alkaline treatments. This process in intended to deal with the first and last mill juice separately, as much first-grade white sugar as possible being made from the first. In regard to the second and other juices, these are clarified by the ordinary process in use in the factory, and run through filters into the decolorizing tank, already used for the first juices, this treatment being repeated before finally passing through the magnesia check filter, if incompletely decolorized. These second-grade juices when concentrated to about 30°Bé. may be mixed with the molasses centrifugalled from the first-grade massecuite, and the whole boiled to grain in the vacuum pans, a good grade of white sugar being again obtained. No cost figures are stated for the method of working elaborated by this correspondent.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.* [2] Assistant Professor and Research Associate, respectively, at the Massachusetts Institute of Technology.

[3] U.K. Patent, 219,194. [4] To whom correspondence may be addressed, c/o Bank of New Zealand, 1, Queen Victoria Street, London, E.C. 4.

REPORT ON THE "NORIT" (DECOLORIZING CARBON) PROCESS AS INSTALLED IN THE RATBOR REFINERY, CZECHO-SLOVAKIA. *Jar. Dedek and K. Zert. Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, No. 3, 4, 5 and 6.*

A close examination of the operation of the "Norit" decolorizing carbon process as installed at the Ratbor Refinery, Czecho-Slovakia, has been made by the Sugar Experiment Station, Prague, and a long report by the authors has been published, this going considerably into detail. Very satisfactory results were obtained with the process operating throughout an entire campaign and on an entirely industrial scale, the principal conclusions drawn from the examination being as follows :—Decolorization and simultaneously clarification by "Norit" showed itself to be simple and certain, being essentially ordinary working by means of filter-presses, these giving excellently compact cakes of carbon. Revivification of the "Norit," particularly by means of the furnace, was easily performed, and a carbon having entirely satisfactory qualities was recovered, while the losses did not exceed 0·05 per cent. of the weight of sugar melted. It was found possible with 1 to 1·5 per cent. of "Norit" (on the weight of sugar) to obtain a constant decolorization of 60 per cent. in the case of the first and second syrups (*clairces*). Decolorization of these syrups by means of "Norit" was found to be equivalent to that of syrups treated with animal charcoal, the resulting refined sugar being of an irreproachable white. Some remarks are made regarding the economical side of the question : It was possible for the greater part to use plant already present in the refinery, viz., presses, heaters and tanks, the only large expense being the furnace, the price of which is given as 140,000 crowns.[1] "Norit" in Czecho-Slovakia costs 9–10 crowns per kilo,[2] while the cost of revivifying, including fuel, labour, and loss of material, was found to amount to about 30 to 35 hellers per kg. Besides the above considerations, the economy effected in regard to pre-filtration (apparatus, filter-cloth, labour and steam), and sulphitation operations ordinarily carried out at Ratbor, must also be taken into account, and these savings must be added to those already obtained by this method of refining sugar.

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[1] The cost of the furnace is about £1600 in the United Kingdom.

[2] "Norit" costs £60 per ton in the United Kingdom (for licencees).

Review of Current Technical Literature.

INVESTIGATIONS ON THE DOUBLE POLARIZATION METHOD FOR DETERMINING SUCROSE.

V. Sazavsky. Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, Nos. 31 and 32, 247-254; 255-262.

Method of inversion.—That found to give the most constant results, while avoiding the errors of "reversion" (diminution of the levo-rotation of the inverted solution) and muta-rotation, was to heat 50 c.c. of a normal solution of pure sugar and 20 c.c. of 6·34 normal HCl (equivalent to 10 c.c. of HCl of 1·188 sp. gr.) in a water-bath at 50° C. for 25 min. (the 100 c.c. flask being submitted to rotary motion meanwhile). After cooling rapidly, and making up the volume, the liquid was polarized about 20 min. after removal from the hot-water bath. *Effect of HCl on the invert reading.*—As the result of a number of determinations, the following formula was found to express the reading (L) of a solution obtained by the inversion of a half-normal solution of sucrose : $L = -31{\cdot}82 - 0{\cdot}126\,C$, in which C is the c.c. of 6·34 normal HCl in 100 c.c. of the liquid polarized. *Walker's inversion method.*[1]—In this procedure 50 c.c. of sugar solution, plus 25 c.c. of water are heated in a 100 c.c. flask to 65°C., 10 c.c. of HCl of sp. gr. 1·1029, or 5 c.c. of 1·1918, added, the liquid mixed, set aside for 15 min., and lastly cooled to 20° C. and completed to volume. Applying this method, inversion was found to be complete when 50 c.c. of a normal solution of sucrose were thus hydrolysed and made up to 100 c.c., but with a sample of beet molasses inversion was not quite complete, a figure of — 6·85 being obtained in comparison with — 7·15 by the HERZFELD method, when using the same amount of acid. Increasing the amount of acid from 10 c.c. of 6·34 normal acid (as specified by WALKER) to 13, however, gave satisfactory results. *Double polarization procedure recommended.*—In the case of molasses, to obtain the direct reading, the double normal weight in a 300 c.c. flask is clarified with 30 c.c. of basic lead acetate, made up to the mark and mixed ; 75 c.c. are pipetted into a 100 c.c. flask, and after making up to the mark (and filtering if necessary) it is polarized at 20°C. For the invert reading, 75 c.c. of the clarified solution in a 100 c.c. flask are acidified with 3 c.c. of 6·34 normal HCl, heated to 65°C. in a water-bath at 70°C., 10 c.c. of 6·34 normal HCl added, and the solution set aside for 15 min. After cooling in a water-bath, the liquid is neutralized with ammonia, cooled to 20°C., completed to volume, mixed, and read at 20°C. Then the constant used in the formula is : $132{\cdot}72 + 0{\cdot}068\,G. + 0{\cdot}193\,C. + 0{\cdot}5\,T. = 145\ 67$ for a concentration of 6·5 grms. in 100 c.c., and a temperature of 20°C., G being the grms. of the inverted sucrose in 100 c.c., C the c.c. of 6·34 HCl in 100 c.c., and T the observation temperature in degrees Centigrade.

HERLES' METHOD OF CLARIFYING BEET MOLASSES FOR POLARIZATION.

Ed. Kunz

Vereins-Zeitschrift, 1924, 206-228.

In Herles' method of clarifying, a solution of the double normal weight of molasses contained in a 200 c.c. flask is treated with 30 c.c. of lead nitrate solution (containing 450 grms. per litre) while submitting the liquid to a rotatory movement, this addition being followed by 30 c.c. of sodium hydroxide solution (50 grms. per litre) after which the liquid is made up to the mark, mixed, and filtered. Basic lead nitrate is formed as the result of the action of the two reagents, which basic compound has a considerably better decolorizing effect than has ordinary basic lead acetate solution of the same lead content. Different workers have shown that the results given by Herles' method are somewhat uncertain,[2] and do not agree well with those given with basic lead acetate clarification. Therefore, the author has thought it desirable to submit it to a close examination with a view to establishing its value, using ordinary beet final molasses. Altogether 149 determinations comparing Herles' method with basic lead acetate clarification were made ; and, in addition to the polarizations, corresponding values expressing the light transmission as measured by the Kruss apparatus were stated. Here are the main conclusions established by the results obtained :—A good decolorization was obtained only when the nitrate and hydroxide solutions were used in equal volumes, and the greater the volume of this clarifying reagent, the lighter the solution, being 48·2 degrees with 5 + 5 ; 68·8 with 10 + 10 ; 77·2 with 15 + 15 ; 81·0 with 20 + 20 ; and 83·3 with 30 + 30 c.c., which latter figure of 83·3 expresses a remarkably good decolorization. But the essential figure is the polarization, and the results with equal volumes were as follows: 5 + 5, 51·52; 10 + 10, 51·54; 15 + 15, 51·16; 20 + 20, 50·83; and 30 + 30 c.c., 50·06, so that with more than 10 + 10 c.c. the polarization fell rather rapidly. This decrease was caused by the lead precipitate carrying down some sugar from solution, which effect was comparatively considerable when the sodium hydroxide was present in excess of the lead nitrate, even when this excess was not great. When small equal volumes were added, viz., 5 + 5 and 10 + 10 c.c, the adsorption effect was practically inappreciable; but with these amounts the decolorization is no better than with the use of 20 or 25 c.c. of basic lead acetate solution (sp. gr. 1·245). On the whole, these observations showed the Herles' polarizations were distinctly lower than those found with basic lead acetate. It is concluded, therefore, that the advantages of Herles' method are doubtful.

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[1] *I.S.J.*, 1917, 31.

[2] Compare *I.S.J.*, 1924, 278.

Determination of the Dry Substance of Beet Juices, etc., using the Desiccation Method. *Robt. J. Brown*. *Industrial and Engineering Chemistry, 1924, 16, No. 7, 746-748.*

It is claimed that results checking within 0·01 per cent. can be obtained in the case of beet juices using the following method: Place 25 grms. of sand (between 30 and 60 mesh, acid-washed, and ignited) in an aluminium dish containing a glass stirring rod; heat for 12 hours at 70-75 °C. with 120 mm. absolute pressure, cool in desiccator (containing fresh acid), and weigh, heating being repeated until constant weight is attained. Add about 5 c.c. of the sample juice from a weighing bottle, mix, re-place the dish in the oven, heat as prescribed for the sand, cool in desiccator for not more than one hour, and weigh. An examination was made of the volatile matter (other than water) given off during heating, and in the case of fresh pressed beet juice this did not exceed at any time 0·007 per cent., and was mainly CO_2 with a trace of volatile acids, while old pressed beet juice showed 0·011 per cent. of volatile acids.

Influence of the Age of the Cloth on the Filtration of Beet Carbonatation Scums. *Jaroslav Hruda*. *Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, No 36, 285-292.*

Comparative tests carried out with two similar filter-presses, one dressed with new cloth, and the other with the same grade of fabric which had been in use for some time, led to the conclusion that the difficulty in the washing of beet carbonatation scums to be observed as a rule in the initial part of the campaign is due to the use of such new material, and not to the chemical composition or to the physical quality of the scums. Even when the scums are ordinarily of good filtrability, it is some time before a sufficient sweetening-off is reached. Probably this irregularity is due to the shrinkage of the cloth accompanied by the obstruction of the pores. An increase in the amount of lime used for defecation during this difficult period of work does not at first eliminate the trouble, though, by improving the quality of the scums, it assists in attaining a more normal state of working. On the other hand, if insufficient lime has been used, the cloth becomes slimed, and the rate of filtration is so retarded that after a few days it is necessary to dismantle the press and wash the cloth. Filter-cloth which has been washed after having been in use for a short time is not improved, as regards its rate of filtration as it behaves in the same way as the used fabric. During these experiments, samples of scum were taken from different parts of the cake from time to time, but it was not found possible to define any particular zone in which sweetening-off was constantly better than elsewhere.

Importance of observing the Temperature in the Determination of the Fine Grain of Molasses. *C. W. Schonebaum*. *Tijdschrift, 1923-4, No. 9, 180-182.*

It is shown in this article that if a beet factory molasses of normal concentration be examined for fine grain at a lower temperature than that at which it was centrifuged in the factory an important error may be caused, due to the crystallization which will result during cooling, this being demonstrated in the following way: Assuming the temperature of the molasses is 45 °C., and its purity 60, its coefficient of saturation is 1·26, so that for every 100 grms. of water present 1·25 × 248 = 310 grms. of sucrose are in solution[1]; but this solubility must be increased by the supersaturation figure, giving 310 × 1·05 = 325·5 grms. of sucrose as the actual amount in solution, At a purity of 60, this corresponds to 100/60 × 325·5 = 542·5 grms. of dry substance, so that the molasses consists of 100 grms. of water, and 542·5 of dry substance, of which 325·5 are sucrose, this giving a percentage composition of 15·6 of water and 50·7 of sucrose. If now the molasses be allowed to cool to 35 °C., the same mode of calculation shows that the sucrose in solution must decrease to 36·6 per cent., so that at 1·05 supersaturation, 50·7 — 36·6 × 1·05 = 12·3 grms. of sucrose will crystallize out as the result of the decreased solubility. Thus, this amount of fine grain would be found by analysis in the laboratory at 35 °C., though at the temperature of centrifuging none at all was present. When, therefore, molasses samples are examined for fine grain, they should previously be raised to the temperature at which they were spun off in the factory. If this degree be not known, then what is believed to be the average should be accepted, though as the result of this uncertainty the possibility of a certain error arises.

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[1] The figure 248 represents the solubility of sucrose in water at 45 °C.

RE-TESTING THE 100° POINT OF THE SACCHARIMETER : [3] POLARIZATION OF THE NORMAL SOLUTION. *A. Kraisy and A. Traegel. Vereins-Zeitschrift, 1924, 193-205.*

Two previous papers leading to the present investigation on the polarization of the normal sugar-weight solution, have been published on the re-testing of the 100° point of the saccharimeter, viz. (1) on the determination of small amounts of invert sugar in the sucrose used for the normal solution[1], and (2) the preparation of the chemically pure sucrose[2]. The purpose of the present investigation was to establish the rotation in degrees Ventzke on the present scale which is produced by a solution of 26 grms. of pure sucrose in 100 c.c. of water when observed in a 200 mm. tube at 20°C , the instrument used being a "precision polarimeter" of SCHMIDT & HAENSCH. Flasks and observations tubes were carefully calibrated, and the error attached to each was determined and before and after each reading of the various sugar solutions the scale of the saccharimeter was compared with one of the quartz plates. Three quartz plates were used: (*a*) from the Bureau of Standards having a value of 99·93 °V. (or 100·04 °S., according to the new Bates scales) ; (*b*) from SCHMIDT & HAENSCH having a value of 99 92 °V. ; and (*c*) also from SCHMIDT & HAENSCH, its value being 98·43 °V., plate (*b*) being chosen for the purpose of the final comparison for all measurements, and plates (*a*) and (*c*) giving the values 99·94 and 98·44°V. respectively when referred to it. Sixteen samples of carefully purified sucrose (highly refined crystals, precipitated by alcohol once or twice, and dried *in vacuo*, having a reducing power corresponding on the average to about 1·8 mgrms. of copper[3]), were prepared each reading being the average of 10 observations by two different operators. An average value of 99·834° was established as the mean of the readings of 9 of the samples of purified sucrose, the remaining 7 excluded being either those prepared by a single precipitation by alcohol, or those which had been dried at 105°C. instead of *in vacuo* over a desiccating agent. Samples prepared by a single precipitation gave an value of 99·82, which differs only very slightly from the general average; but those which had been heated to 105°C. showed a somewhat higher average polarization, namely 99·878°V. (their reducing power being 2·6 mgrms. of Cu), possibly because during the heating dexto-rotatory bodies had been formed. This value of 99·834 agrees well with the results of other workers, namely, BATES who found 99·895, and STANEK who obtained 99·90 to 99.81 °V. Calculating this result of 99·834 to circular degrees (using Schonrock's values) 34·609° is obtained, corresponding to a specific rotary power, $\left[\alpha\right]_{D}^{20}$ of 66·516.

CROP DATA OF THE LA CARLOTA CENTRAL, P. I. *H. Gifford Stower. Communicated by the Central Azucarera de la Carlota, Negros Occidental, Philippine Islands.*

A few details of the last crop of La Carlota Central,[4] which has proved a record for the Philippine Islands are here given :—Milling started, November 12th, 1923 ; milling finished April 3rd, 1924 ; possible milling days, 125 ; days of 24 hours, 114—20/24 ; time lost due to factory, 65·56 hours; time lost due cane, 72·51 hours; capacity of mill, 2000 tons; milled for possible milling days, 2233 tons the 24 hours; milled for days of 24 hours, 2341 tons; cane milled, total, 269,228 tons; sugar manufactured, 34,261 tons, sugar manufactured, 595,849 bags; and tons of cane per ton of sugar, 7·86.

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[1] *I.S.J.*, 1921, 347. [2] *Ibid.*, 1922, 156.

[3] That is, invert-sugar free, the reduction indicated being due to the sucrose itself.

[4] For a previous Report of this Central, see *I.S.J.*, 1923, 380.

Use of Lime containing Magnesia for the Carbonatation of Beet Thick-Juices (Intermediate and Final Evaporator Syrups). **Wenzel Kohn.** *Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, Nos. 33 and 34, 263-268, 271-274.*

Continuing the work on the value of dolomitic lime for carbonatation previously reported,[1] the author has now studied the question as applied to the clarification of the evaporator syrup (so-called intermediate and final thick-juice). He used milk of 18° Brix, containing CaO, 15·22 per cent., and MgO, 8·01 per cent. The syrups heated to 50°C. were treated with a certain volume of this milk, and carbonatated at 80°C. to an alkalinity of 0 1 per cent. CaO, being after filtration re-carbonatated to 0·01 per cent. CaO, reheated, and filtered. In the case of intermediate syrup using 0·5 per cent. of the dolomitic lime by volume on the amount of syrup treated the purity was increased by 0·27 to 0·45°, while the decolorization was 38 to 47 per cent. of the original colour present. Using 1·0 per cent. of the dolomitic lime, the increase of purity was 0·45 to 1·0°, and the decolorization 39 to 47 per cent. In the case of the final evaporator syrup, using 1·0 of the dolomitic lime, the increase of purity was 0·18°, and the decolorization 51 per cent. Neither lime nor magnesia passed into the carbonatated and filtered syrups.

Experimental Data on the Exhaustion of Molasses by the Baryta Process in Italy. **Emile Saillard.** *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France, Nos. 1830, 1833, 1835.* Cornstalk Syrup Production. **J. J. Willaman, G. O. Burr, and F. R. Davison.** *Industrial and Engineering Chemistry, 1924, 16, 734-739.* Fermentation of Natural Fruit Juices. **B. A. Dunbar and C. F. Wells.** *Ibid., 1924, 16, 739-740.* Catalytic Oxidation of Galactose to Mucic Acid. **E. O. Whittier.** *Ibid, 1924, 16, 744-745.* Chemical Examination of Sugar Products for their Content in Sugar and Starch. **Anon.** *Vereins-Zeitschrift, 1924, 264-273* Review of Methods for the Recovery of Sugar from Molasses, including Deguide's New Process. **Edmund Vrancken.** *Vereins-Zeitschrift, 278-297.* Remarks on the Preceding Article. **Anon.** *Ibid., 297-300.* Gel-forming Power of Fruit Juices and Pectin Solutions with Conclusions for Practical Jam Making. **W. Wendelmuth.** *Koll.-Chem. Beih., 1924, 19, 115-117.* Evaporating and Drying Plant. **S. G. Ure.** *Chemistry and Industry, 1924, 42, No. 12, 294-303.* Evaporation Rate of some Solutions, including Sugar. **L. S. Bagster.** *Journal of the Society of Chemical Industry, 1924, 43, No. 12, 61-65T.* Improvements in the Hot Saccharate Process of Extracting Sugar from Beet Molasses. **R. W. Shafor.** *Chemical and Metallurgical Engineering, 1924, 31, 107-110.* Carbonatation, Continuous and Intermittent. **Jules Bothy.** *Bull. Assoc. Chim. Sucr. 1924, 462.* Manufacture of Sodium Hydrosulphite. **L. A. Pratt.** *Industrial and Engineering Chemistry, 1924, 16, No. 7, 676-677.* Comparison of the Multiplex Film Evaporator with other Types. **Burton Dunglinson.** *Chemical and Metallurgical Engineering, 1924, 25, No. 3, 110-115.* Evaporation by Vapour Compression. **Burton Dunglinson.** *Chemical and Metallurgical Engineering, 1924, 25, No. 6, 246-247.* Studies in Evaporator Design: Relation between Hydrostatic Head and Heat Transmission in Horizontal Tube Apparatus. **W. L. Badger.** *Chemical and Metallurgical Engineering, 1924, 25, No. 10, 459-463.* Studies in Evaporator Design: Effect of Surface Conditions. **L. A. Pridgeon and W. L. Badger.** *Industrial and Engineering Chemistry, 1924, 16, No. 5, 474-478.*

J. P. O.

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[1] *I.S.J.*, 1922, 270, 1923, 103.

Review of Recent Patents.[1]

UNITED KINGDOM.

Mill Rollers having Circumferential or Helical Grooves. *W. Mackie and A. & W. Smith & Co., Ltd.*, of 120, Dale Street, S. S., Glasgow, Scotland. *216,434.* October 18th, 1923. (Seven figures; six claims.)

The invention relates to mill rolls of the type having intermeshing circumferential or helical surface grooves, and has for its object an improved form and contour of grooving applicable (it may be in varying pitches and proportions) throughout the mill and also—and more particularly—to pairs of preliminary crushing rolls of which there may be any convenient number. In a roll according to the invention there is a primary series of grooves the sectional contour of which is triangular, the flanks lying at equal and opposite angles to planes of rotation bisecting them. Upon the flanks of these triangular grooves there are formed any convenient number of secondary grooves (and corresponding counterpart projections). These secondary grooves are in contour similar to the primary grooves; that is to say, they are preferably equi-angular; alternatively, however, they may be of unequal angles; for instance one surface may be normal to the plane of rotation. The points of the projections and the roots of either or both primary and secondary grooves may be flattened or rounded. A roll made according to the invention thus gives greater gripping capacity, more crushing surface and more channels for the outlet of juice than is obtained when the flanks of the primary grooves are left plain as usual. Referring to the drawings, it is seen that the roll has a series of triangular circumferential grooves A^1 (Figs. 1 and 3), a series of secondary grooves A^3, and counterpart projections A^4 formed in the flanks A^2 of the grooves A^1. The flanks A^2 of the grooves A^1 lie at equal and opposite angles to planes of rotation, and the flanks of the grooves A^3 and A^4 are equiangular to planes of rotation. The usual helical grooves A are provided in the roll. Fig. 4 shows two series of secondary grooves A^3 and projections A^4 formed in the flanks of the primary grooves A^1. As shown in Fig. 5, the secondary groove A^3 and projection A^4 have each one flank B normal to the plane of rotation, the second flanks B^1 being inclined. The points of the projections and the roots of either or both primary and secondary grooves may be flattened or rounded.

FIG. 3.

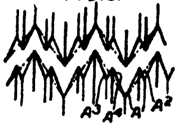


FIG. 4.

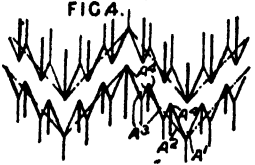


FIG. 5.

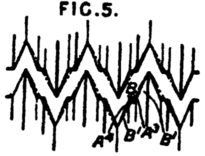
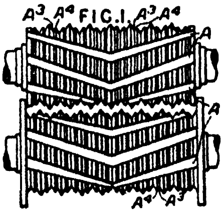


FIG. 1.



Starch Glucose and Dextrin. *Dextrin Automat Ges.*, of Vienna. *215,705.* August 4th, 1923; convention date, May 9th, 1923.

Starch is liquified by introducing it into boiling acid which is agitated and maintained at a high temperature by jets of hot air, after which the vessel is closed and the pressure increased, either by continuing the boiling or by introducing hot compressed air, when the starch is saccharified. Saccharification is preferably effected at a pressure of from 3 to 6 atmospheres and a temperature of from 100 to 105°C.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

ALCOHOL MOTOR FUEL. (*A*) ***H. Terrisse***, of Geneva, Switzerland. *216,169*. August 31st, 1923. (*B*) ***Badische Anilin & Soda-Fabrik***, of Ludwigshaven-on-Rhine, Germany. *215,776*. May 8th, 1924; convention date, May 8th, 1923. (*C*) ***D. Annaratone***, of Turin, Italy. *217,873*. September 17th, 1923; convention date, June 5th, 1923. (*D*) ***G. Henneberg and M. H. Charpentier***, of Paris, France. *217,882*; addition to *213,526*. March 20th, 1924; convention date, June 20th, 1923.

(*A*) Motor spirit is produced by adding ethyl alcohol and acetaldehyde to petrol, benzene, or kerosene or other hydrocarbon heavier than petrol. Paraldehyde, ether, gasolene, light petrol, and acetone may also be added. The acetaldehyde is preferably neutralized before use by calcium carbonate or other salt having no alkaline reaction. The alcohol-acetaldehyde mixture may be prepared first, and preferably by passing vapours of ether-alcohol over copper or other catalyst. In an example 20 litres of kerosene, 60 litres of heavy petrol, and 20 litres of a mixture of 2 litres of alcohol to 1 litre of acetaldehyde are used. (*B*) Raw methyl alcohol obtained by the catalytic treatment of hydrogen and oxides of carbon is used as a motor spirit. Benzene or other fuel may be added. (*C*) Fuels for internal-combustion engines of all kinds are obtained by mixing a series of ingredients having gradually diminishing volatilities and higher boiling points so as to form a complete chain. In an example of a motor spirit there are mixed together 20 c.c. of ether. 25 c.c. of alcohol or benzol, 14 c.c. of heptone, 8 c.c. of toluol, 4 c.c. of fuel oil, 3 c.c. of xylol, 2·5 c.c. hydrogenated cresol, and 2·5 c.c. of decahydro-naphthalene. (*D*) In the preparation of a fuel comprising a solution of acetylene in acetone and alcohol, dehydrated by calcium carbide, the apparatus described in the parent specification is modified by use of a series of heaters and dehydrators arranged in cascade to the stills, and by use of tanks in which the lime settles out before the alcohol passes to the next dehydrator.

DEHYDRATION OF ALCOHOL. ***Soc. Ricard, Allenet & Cie.***, of Melle, Deux-Sèvres, France. (*A*) *211,454*. January 22nd, 1924; convention date, February 16th, 1923. (*B*) *217,172* January 23rd, 1924; convention date, June 7th, 1923.

(*A*) Aqueous alcohol is distilled in the presence of a liquid forming with alcohol and water an azeotropic mixture which yields a mixture of alcohol, water, and added liquid (i.e., one having a constant boiling point, leaving a residue from which dehydrated alcohol is obtained by further distillation), such liquids being hydrocarbons, alkyl chlorides, ethylene and acetylene chlorides, carbon tetrachloride, etc. (*B*) In this specification a gasolene which contains no constituents distilling below 80°C., and which has a distilling range of only a few degrees, is named as the added liquid.[1]

DECOLORIZING CARBON. (*A*) ***Soc. Francaise des Glycérines***, of Paris. *215,327*. March 27th, 1924; convention date, May 1st, 1923. (*B*) ***H. Müller-Clemm and Ges. für Chemische Produktion***, both of Mannheim, Germany. *216,130*. May 13th, 1924; convention date, May 14th, 1923. (*C*) ***J. Y. Johnson (Badische Anilin & Soda-Fabrik)***, of Ludwigshafen-on-Rhine, Germany. *216,761*. September 17th, 1923.

(*A*) A decolorizing and deodorizing carbon is obtained by heating organic materials such as sugars, gums, fecula, starch, cellulose, waste skins, leather, wool, peat, and lignite with phosphoric acid. An example shows the impregnation of wood shavings with phosphoric acid and carbonization at about 400°C. To remove the phosphoric acid the product is washed, dried and pulverized. (*B*) Decolorizing carbon is produced by carbonizing a mixture of carbonaceous material and alkali sulphide or polysulphide with or without alkali carbonate. In an example, sulphite cellulose waste-lye is mixed with potassium sulphide, carbonized, and leached with water, the crude lye thereby obtained being used for a further quantity of sulphite cellulose. (*C*) Active carbon is prepared by placing a carbonaceous material, such as coal, anthracite, lignite, peat, wood or charcoal, with or without previous impregnation with alkalies or salts, such as potash or zinc chloride, on a permeable layer of fireproof material in a shaft furnace and blowing through the whole hot combustion gases with or without steam with sufficient pressure to agitate the carbonaceous material.

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[1] See also *I.S.J.*, 1923, 165.

JELLY MANUFACTURE. *Douglas-Pectin Corporation*, of Rochester, New York, U.S.A. (assignees of *R. Douglas, W. A. Bender, and H. Loesch*). *214,957*. February 27th, 1924; convention date, April 23rd, 1923.

A base for jellies is prepared by mixing finely powdered pectin with powdered sugar, the sugar being not less than 50 per cent. of the mixture, and preferably 90 per cent. It is stated that pectin is more easily dissolved in water in such a mixture than by itself. It may be prepared by precipitating a concentrated aqueous solution of pectin, produced as described in U.K. Specification 12,439 of 1913, with ethyl alcohol, drying the precipitate, and grinding it in a porcelain ball mill with flint pebbles, the alcohol being added to the pectin solution, not the solution to the alcohol. The product may be used in jam or jelly-making as described in U.K. Specification 19,192 of 1913. Processes for making strawberry jam and plain jelly by means of the mixture are described.

UNITED STATES.

CARRIER [ABSORBING MATERIAL] FOR MOLASSES FODDER. *William B. Oliver*, of Collingswood, New Jersey, U.S.A. *1,497,461*. June 10th, 1924.

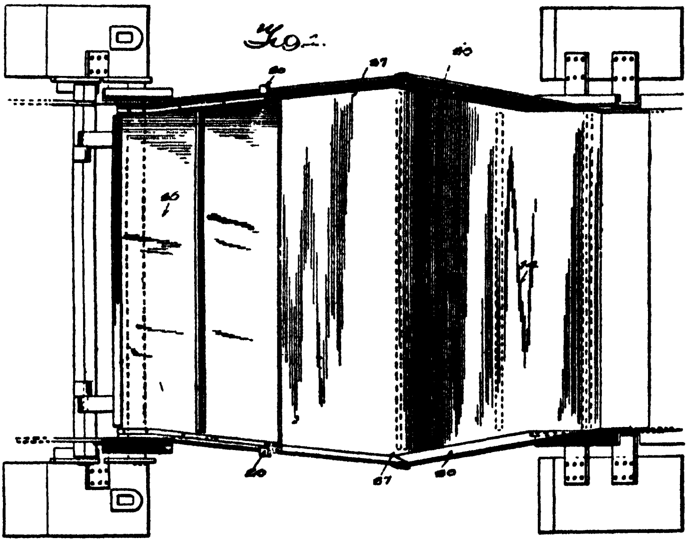
Cereal bran (preferably that of wheat) is used as the absorbent, being capable of taking up at least 75 per cent. of its weight of molasses, so that after allowing the mixture to stand in contact with air or other drying medium there results as a final product a homogeneous granular substance in which "the flakes are distorted in such manner as to form with the finer particles of the medium the individual grains of the product." This material may be readily mixed with the usual grains or concentrates which are to stock in the compounding of balanced rations, no trouble from the accumulation of the molasses in mass being experienced. Details of its manufacture are as follows: Bran or other carrier medium may either be heated or exposed to drying air currents, preferably warm. Dried or otherwise, the medium is mixed with molasses and the mixture heated in a hot oven or dryer for a short time to eliminate excessive moisture. To facilitate the mixing operation, the molasses may be heated in advance to give the desired fluidity, but it is preferable that the preheating temperature be not greater than 105° F. The mixture, which now is semi-dry and somewhat gummy, and with a tendency to dry in mass, is placed in a suitable mixer, and while agitating a meal or flour, or, in fact, any dust-like material, is added, preferably having flakes of non-soluble and but slightly absorbent nature, such as middlings, ground oats, corn meal, or ground hay or straw. The mixture of molasses and edible carrier quickly breaks up into small irregularly shaped masses or nodules, each quickly coating itself with a layer of dust, and the hard insoluble flakes overcoming any further tendency to objectionable packing or massing of the material. Under these conditions, it is assured that the material will carry, store and remain in suitable condition for a stock food ingredient.

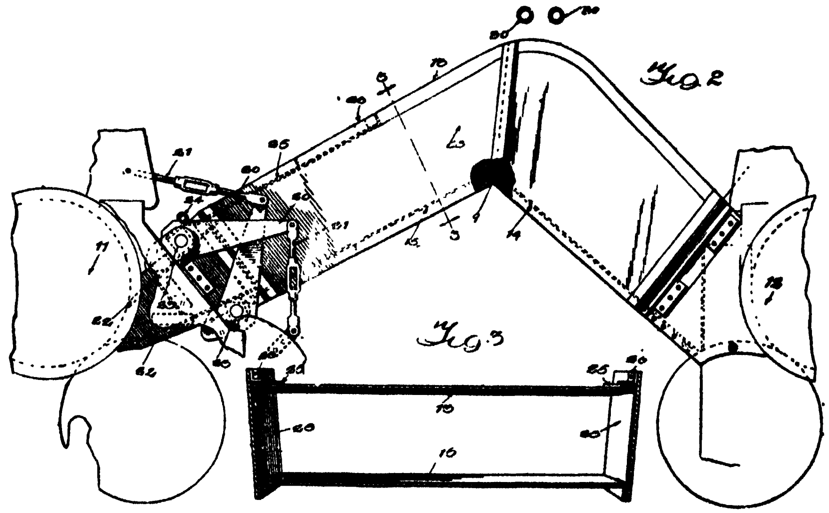
CANE HARVESTER OR CUTTING AND STRIPPING MACHINE. *Francisco S. Curbelo*, of Cienfuegos, Cuba. *1,468,195*. September 18th, 1923.

A machine is provided for cutting the standing cane, stripping it, removing the tops, and cutting the stripped stalks into comparatively short lengths. Claim 8 reads as follows:—In a cane cutting machine, a vertically and laterally swinging frame, a cutting mechanism mounted in the frame for cutting the sections from the standing cane stalks and simultaneously cutting the tops of the upper sections and the other sections into short pieces, a guiding and stripping device carried by the frame in front of the cutting mechanism, a top elevating and delivering means mounted at one side of the cutting mechanism and connected with the frame, means for swinging the frame laterally back and forth, and means for raising and lowering the frame.

Intermediate Feed Chute for Mills. *Joseph Meinecke*, of Paia, Maui, T.H., (Assignor of one-half to *W. A. Ramsay*, of Honolulu, T.H.). *1,497,181.* June 10th, 1924.

This invention is an improvement on that disclosed in U.S. Patent 1,401,095.[1] The old construction disclosed in the patent referred to and repeated here comprises the chute generally designated *13*. This chute includes a bottom plate *14* disposed at an angle of





from 30 to 45° (preferably 45°) from the horizontal, and another bottom plate *15* which is disposed preferably at an angle of from 30 to 45° from the horizontal, eliminating all moving parts so that there can be no delay due to the breakage of chain slats, etc. The bottom plate (of which *14* and *15* are parts) bends at the summit *9*, which must be crossed by the bagasse upon being discharged by the mill *11* on its way to the mill *12*. The intake side *15* of the chute *13* has scrapers *22* which engage the expressing rollers of the mill *11*, so as to remove any of the substance which would otherwise adhere to the surfaces and be carried around. The intake or receiving side *15* is of less inclination than the discharge side *14*. The steepness of the discharge side *14* facilitates the expulsion of the mass of bagasse after it crosses the summit *9*. Bars *23* carry plates to which the scrapers *22* are attached. Each of the scraper bars has a lever *20* at each end. Rods *21* with turn buckles are attached to the ends of the levers and to fixed parts of the frame. The turnbuckles are turned to set the scrapers *22* in respect to the expressing rolls in the mill *11*. The receiving end of the chute *13* has a cover *25*, which may extend as far toward the summit as conditions may require, and is hinged at *24* so that it may be lifted. It carries clips *26* at the free end to rest on the edges of the chute sides.

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[1] *I S.J.*, 1922, 217; see also U.S. Patent, 1,464,914; *I.S.J.*, 1923, 666.

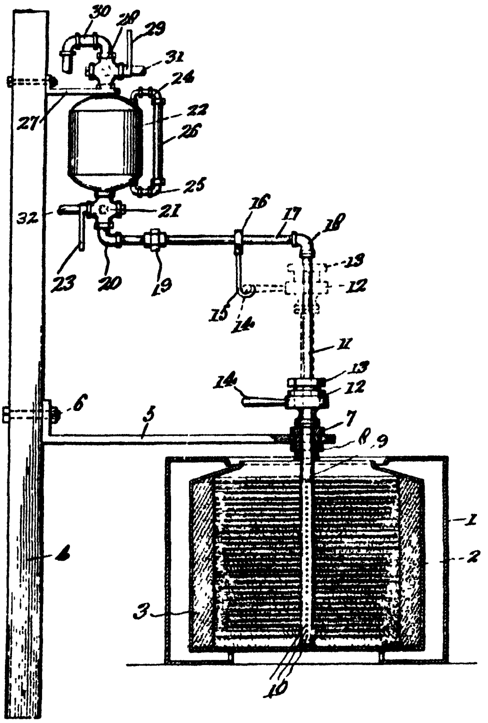
Other details of construction of the chute need have no direct bearing on the improvement, which resides wholly in the middle chute structure. Fig. 1 shows the chute *13* to have been widened at *27* across the summit *9*. In other words, the widest part of the chute is across the ridge or summit. From this point, the sides converge or taper until they assume the normal width at the mills *11* and *12*. The walls or sides of the chute slant outwardly or diverge at *28*. The widening of the chute at the summit in the manner described has been found to cause a more efficient operation than the straight-sided chute of the co-pending application. Pipes *30* (Fig. 3), perforated underneath, sprinkle the bagasse with water as it passes the summit *9*. Obviously, the widened chute summit lengthens the sprinkling area. A better penetration of the bagasse by the water is secured because of the thinning of the strata of bagasse when crossing the summit, which thinning is caused by the spreading of the mass when it reaches the widened zone *27*. The bagasse is ejected from the mill *11* at a given speed, and moves up the incline *15* at a given speed. Obviously, the rate of movement of the mass diminishes as the chute widens toward the summit *9*, which slackening of speed of the mass is an additional aid to the penetration thereof by the water from the pipes *30*.

MACHINE FOR CUTTING CANE. *José Vilar y Pazos*, of Trinidad, Cuba. *1,459,247*. June 19th, 1923.

A machine is provided for effecting the cutting of cane by means of mechanically operated knives which cut the cane at their foot on the field. The machine also includes means for taking up the cut cane to a discharge chute arranged at a higher plane, where it is received by an operator who tops it off using knives mechanically operated by the same machine and then cuts the topped cane in the desired pieces, the machine being also provided with a receptacle where the pieces of cane are deposited. According to Claim 2, the machine comprises a motor truck; a frame opened at its front and rear parts and formed by two vertical parallel plates spaced apart and swingingly mounted in the front part of the truck; two horizontal circular saws rotatably mounted adjacent to one another and one below the other; triangular indented knives horizontally secured at the lower front part of the vertical plates and with the narrower portions projecting forwardly and approximately on the same horizontal plane as the rotatable knives; an endless conveyor arranged between said plates and presenting projecting means for the cut cane a discharge chute inclined towards the bed of the truck and into which the conveyor discharges; a shaft between the sides of the upper part of said chute and having at a point exterior of said chute a topping knife and also having a severing knife for severing the cut and topped cane; a receptacle detachably arranged on the rear part of the truck below the inclined discharged chute; means for moving said receptacle and means for securing the receptacle; means actuating the truck motor to move the knives which cut the cane, the conveyor of the cut cane and the topping and severing knives; means for raising and lowering the knives which cut the cane and means for suspending and securing the swinging frame in inoperative position.

SPRAYER FOR WASHING SUGAR IN CENTRIFUGAL MACHINES. *William P. Weber*, of White Castle, Louisiana, U.S.A. *1,492,499*. April 29th, 1924.

Referring to the drawing, *1* designates a centrifugal having the rotary basket *2*, in which the sugar crystals are indicated at *3*, in a layer against the wall of the basket in readiness to discharge. The standard *4* is adapted to receive a bracket arm *5* connected thereto as by a bolt or other fastening *6* passing through the angled end of the bracket arm: and this bracket arm at its free end is adapted to overlie the central portion of the centrifugal basket. At this point said arm is perforated to receive the brass or other bushing *7*, secured to the bracket arm as by the lock nut *8* threaded thereon and bearing against the under-side of the bracket. Through this bushing extends slidably a pipe *9* having numerous perforations *10* therein, which preferably extend in rows spaced angularly about the pipe and adapted to throw minute streams horizontally against the layer of sugar *3*, while the centrifugal *2* is rotated. The pipe *9* is adapted to extend within a short distance of the base of the centrifugal, and at lower end is closed to avoid the escape of the wash-water. At its upper end the pipe telescopes over a supply pipe *11* of lesser diameter, there being a stuffing box *12* at the upper end, of the distributor pipe *9* to avoid leakage and to provide a tight joint. The stuffing box *12* forms a suitable enlargement upon the upper end of the pipe to which to attach a relatively large and weighty handle *14* by which the distributor pipe may be raised to the position indicated in dotted lines. Here the handle is engaged with a hook *15* suspended from a collar *16* carried upon the horizontal pipe *17* which is connected by the elbow *18* to the vertical supply pipe *11*. The base of the supply pipe *11* which is open and in communication with the interior of the distributor pipe *9* should be just above the uppermost of the perforations *10* when distributor pipe is in the lower position. Pipe *17* may be provided with suitable unions, as *19* and connects as by an elbow *20* with a 3-way valve casing *21*, the upper branch of which is connected to the base of the tank *22*. The third branch of the casing *21* is connected to a water supply and a valve arm *23* is provided to either put the tank *22* in communication with the water supply, or place the tank *22* in communication with the pipe *17*. The tank carries connections *24* and *25* for the attachment of a glass gauge-glass *26* to show the condition within the tank.



When the process of separation in the centrifugal basket *2* is finished, and the sugar is in readiness to be washed, the heavy handle *14* is disconnected from the hook *15*, and the distributor pipe *9* is allowed to descend through the bushing *7* until it arrives at a lower position within the centrifugal whereupon the lower position of the packing box will abut upon the upper flanged end of the bushing *7* and arrest a further downward movement. The valve handle *23* of the valve casing *21* is turned in the position indicated to place the water supply in communication with the tank *22*, and a suitable amount of water is allowed to enter the tank, the amount being shown by the gauge *26*. Subsequently, the valve handle *29* of the upper casing *28* will be turned appropriately to permit the entrance of compressed air above the water in the tank. Then the water will be allowed to flow down into the pipe *17* by shifting the valve handle *23*, and the water will descend under considerable pressure through the vertical supply pipe *11* and into the distributor pipe *9*, issuing under force out of the minute perforations *10* in small jets which impinge against the sugar crystals, purging them. This action is allowed to go on for a period of time while the centrifugal is rotated, and in this way the crystals are thoroughly washed before being discharged. As soon as the washing operation is over, tho distributor pipe *9* is lifted out of the centrifugal so as to avoid interference with future operations, and it is held suspended by the engagement of the handle *14* with the hook *15*. Lastly, the overflow *30* is opened.

AUTOMATIC SACKER FOR SUGAR. *Elza H. Moraine,* of Guthrie Center, Iowa, U.S.A. *1,469,673.* October 2nd, 1923.

A device is provided for quickly, cleanly and conveniently filling sacks or other receptacles with sugar, or the like, one of the principal claims made in the specification of this invention being as follows: In a device of the class described, the combination of a cabinet having a tower and a horizontally extending open top base, a bin, means for moving the bin in said cabinet from said tower into said base to permit said bin to be filled in its lower position and to discharge in its raised position, a lid arranged in said cabinet, means for operating said lid to close the open top of said base and to provide a support for receptacles to be filled by the bin when said bin is positioned in said tower, and means constructed and arranged to cause said lid to shift on the lowering of said bin whereby said bin may be positioned within said base for filling.

ROTARY FILTER PROVIDING FOR THE AUTOMATIC REMOVAL OF THE CAKE. *Arthur Wright and Frank W. Young,* of Verona, New Jersey, U.S.A. *1,472,574.* October 30th, 1923.

One of the objects of the invention to provide a process which will rapidly and efficiently, as well as economically and effectually, remove the filter-cake from the filtering medium and, further, will maintain it substantially intact and transport it in its ribbon or sheet-like form to any desired apparatus for its further treatment, so that it may be readily dried, or in other ways treated and handled. Claim 17 reads as follows: An apparatus of the class described comprising a filter including a rotary drum, a cake reinforcing and stripping member constructed as an endless belt and extending around said drum, adapted to be embedded within the cake and to reinforce and strip it from said drum, means whereby said reinforcing and stripping member is adapted to convey said cake to the cake-treating apparatus, and a cake-compressing mechanism including an endless belt resiliently pressed against the cake when located upon the drum and containing the cake-reinforcing and stripping member therein.

CARBONACEOUS FILTERING MATERIAL. *William Jones* (assignor to *Vesta M. Jones,* of New York, U S.A.). *1,496,229.* June 3rd, 1924.

A calcium salt is precipitated in solution with an alkali-metal phosphate and an alkali-metal carbonate, the product washed free of soluble salts, dried, ground, mixed with a carbonaceous substance and finally calcined.

DECOLORIZING CARBON. (*A*) *Clarence P. Wilson* (assignor to *California Fruit Growers' Exchange,* of Los Angeles, Cal., U.S.A.). *1,498,708.* June 24th, 1924. (*B*) *Alice M. Hart* (assignor to *Edmund R. Cummins,* of Worcester, Mass., U.S.A.). *1,501,111.* July 15th, 1924.

(*A*) Porous refractory material and organic matter are mixed together, pressure applied to the mixture, and the mass heated sufficiently to drive off the volatile matter, the deposition of a decolorizing carbon within the refractory material thus being caused. (*B*) Materials to be carbonized are treated with a metallic salt of a nature to prevent carbonization thereof under heat, and then the mass subjected to heat in the presence of air.

PUMPS. (A) *Walter R. Woock, and others,* of Lodi, Cal., U.S.A. *1,473,802.* November 13th, 1923. (B) *William C. Dowd,* of Quincy, Ill., U.S.A. *1,473,904.* November 13th, 1923. (C) *Everett B. Cushman,* of Lancing, Mich., U.S.A. *1,473,924.* November 13th, 1923. (D) *J. W. W. Drysdale,* of Yoker, near Glasgow, Scotland. *1,474,708.* November 20th, 1923.

Sugar Crops of the World.

(Willett & Gray's Estimates to August 28th, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
United States—Louisiana	Oct.-Jan.	144,664	263,478	289,669
Texas	,, ,,	2,600	2,875	2,920
Porto Rico	Jan.-June	397,740	338,456	362,442
Hawaiian Islands	Nov.-July	571,800	479,463	502,194
West Indies—Virgin Islands	Jan.-June	2,000	1,739	5,000
Cuba	Dec.-June	4,075,000	3,602,910	3,996,387
British West Indies—Trinidad	Jan.-June	55,000	41,619	59,948
Barbados	,, ,,	45,000	52,715	36,742
Jamaica	,, ,,	33,000	33,029	42,167
Antigua	Feb.-July	8,500	12,642	9,850
St. Kitts	Feb.-Aug.	10,000	10,735	8,426
Other British West Indies	Jan.-June	8,000	5,292	9,238
French West Indies—Martinique	Jan.-July	17,000	19,700	18,329
Guadeloupe	,, ,,	25,000	25,043	22,393
San Domingo	Jan.-June	229,373	184,171	157,143
Haiti	Dec.-June	10,000	10,967	12,283
Mexico	,, ,,	165,000	119,457	119,800
Central America—Guatemala	Jan.-June	22,000	24,445	19,090
Other Central America	,, ,,	56,000	50,336	55,990
South America—				
Demerara	Oct.-Dec. and May-June	95,494	101,128	107,797
Surinam	Oct.-Jan.	10,000	11,719	10,931
Venezuela	Oct.-June	18,500	16,000	16,000
Ecuador	Oct.-Feb.	17,000	14,220	13,318
Peru	Jan.-Dec.	275,000	313,743	319,864
Argentina	May-Nov.	257,349	209,718	172,236
Brazil	Oct.-Feb.	425,000	595,723	491,933
Total in America		6,975,920	6,541,323	6,862,090
Asia—British India	Dec.-May	3,266,000	3,044,000	2,532,500
Java (1924-25: 1,885,000)	May-Nov.	1,771,772	1,746,875	1,649,610
Formosa and Japan	Nov.-June	433,559	405,800	406,966
Philippine Islands	,, ,,	335,341	263,437	338,160
Total in Asia		5,806,672	5,460,112	4,927,236
Australia (1924-25: 350,000)	June-Nov.	281,859	306,678	299,465
Fiji Islands	,, ,,	58,000	36,350	71,731
Total in Australia and Polynesia		339,859	343,028	371,196
Africa—Egypt	Jan.-June	100,000	94,554	108,963
Mauritius	Aug.-Jan	201,550	231,190	197,420
Réunion	,, ,,	50,000	42,872	55,564
Natal	May-Oct.	180,463	158,221	155,194
Mozambique	,, ,,	60,000	45,950	34,446
Total in Africa		592,013	572,787	551,587
Europe—Spain	Dec.-June	12,000	13,918	13,805
Total cane sugar crops		13,726,464	12,931,168	12,725,914
Europe—Beet sugar crops		5,033,106	4,514,322	3,973,100
United States—Beet sugar crop	July-Jan.	787,217	615,936	911,190
Canada—Beet sugar crop	Oct.-Dec.	16,500	12,400	18,931
Total beet sugar crops		5,836,823	5,142,658	4,903,221
Grand total Cane and Beet Sugar	**Tons**	**19,563,287**	**18,073,826**	**17,629,135**
Estimated increase in the world's production	,,	**1,489,461**	**444,691**	**866,143**

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.	1923. Tons.
Total Receipts, January 1st to August 27th	2,321,604	2,181,512
Deliveries ,, ,,	2,285,034	2,167,215
Meltings by Refiners ,, ,,	2,212,710	2,061,960
Exports of Refined ,, ,,	130,000	195,000
Importers' Stocks, August 27th	37,364	14,297
Total Stocks, August 27th	114,927	117,471
	1923.	1922.
Total Consumption for twelve months	4,780,684	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons	1923-24. Tons.
Exports	2,377,510	2,602,339	2,505,959
Stocks	844,622	590,209	788,141
	3,222,132	3,192,548	3,294,100
Local Consumption	75,000	67,500	62,000
Receipts at Ports to June 30th	3,297,132	3,260,048	3,356,100

Havana, June 30th, 1924 J. GUMA.— L. MEIJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to August 28th, 1924.)

	Harvesting Period.	1923-24. Tons.	1922-23. Tons.	1921-22. Tons.
Germany	Sept.-Jan.	1,125,000	1,463,000	1,305,810
Czecho-Slovakia	Sept.-Jan.	1,030,000	733,825	659,907
Austria	Sept.-Jan.	48,000	23,976	16,322
Hungary	Sept.-Jan.	125,000	81,603	74,898
France	Sept.-Jan.	495,000	490,360	306,073
Belgium	Sept.-Jan.	300,000	268,928	289,866
Holland	Sept.-Jan.	232,000	255,592	379,770
Russia (Ukraine, etc.)	Sept.-Jan.	366,742	193,400	49,374
Poland	Sept.-Jan.	378,600	294,269	179,096
Sweden	Sept.-Jan.	153,890	71,790	231,066
Denmark	Sept.-Jan.	102,358	88,382	146,800
Italy	Sept.-Jan.	311,450	261,607	217,532
Spain	Sept.-Jan.	185,000	160,035	72,257
Switzerland	Sept.-Jan.	5,500	6,033	5,856
Bulgaria	Sept.-Jan.	26,566	16,250	12,712
Roumania	Sept.-Jan.	80,000	49,872	25,761
Other Countries	Sept.-Jan.	68,000	55,400	—
Total in Europe		5,033,106	4,514,322	3,973,100

United Kingdom Monthly Sugar Report.

Our last report was dated the 8th August, 1924.

The market has been steady to firm throughout the whole period under review and prices generally are 1s. to 2s. per cwt. higher than a month ago.

The terminal market has presented a sold-out appearance with lack of offers from the Continent and there has been a general desire to cover "bears"; at the same time the position has encouraged speculators to take more interest in new crop. August was finally liquidated at 24s., October has advanced from 22s. to 23s. 6d., November from 20s. to 21s. 10½d., December from 19s. 10½d. to 21s. 3d., whilst March sold from 20s. to 20s. 9d. No violent fluctuations have been experienced, but there has been a gradual hardening of prices, especially in the nearer discount months. The latest prices are: September, 24s.; October, 23s. 7½d.; December, 21s. 6d.; March, 20s. 10½d.

Trading in actual sugars has been much more brisk and a good business has been done in all descriptions. The trade in this country were very bare of stocks and the demand from the actual consumer continuing they were forced to buy any available supplies. Coinciding with this, European countries—such as Spain, Russia, etc.,—again came into the market and competed with the trade here to get further supplies. A large export business was done from London to the Continent and the stocks in the U.K. became rapidly depleted.

It is interesting to note that not only has Germany stopped exporting, but in the last few weeks she has become an importer. The actual exports from Germany since 1st October, 1923, are 144,576 tons.

Fine Granulated on the spot has advanced from 36s. 5d. to 38s. 6d. White Javas from 35s. to 36s. 6d. Continental Granulated for prompt shipment has been exceedingly scarce and only isolated transactions have taken place in Dutch up to 27s. f.o.b A large business has been done in American Granulated c.i.f. from 24s. to 26s White Javas are rapidly adsorbed and sold from 22s. to 23s. 3d. c.i.f., the latest price is 22s. 10½d. Much more interest has been shown in new crop and Czecho Granulated for November sold from 20s. 3d. to 21s. 9d , and Dutch Granulated for November/December from 20s. 3d. to 22s.

The British Refiners in the absence of competition maintained a firm attitude and have made a series of advances, viz , 6d. per cwt. on August 12th, 6d. on August 18th, 6d. on August 20th, and 6d. on September 4th. The latest quotations are No. 1 Cubes 45s. 6d., London Granulated, 40s. 3d.

Business in raws has been active and the refiners have been continual buyers throughout the month. Business has been done in Cubans 96 per cent. from 17s. 6d. to 19s. 9d. About 30,000 tons of Preferential Australian 96 per cent. were sold for September shipment at the parity of 17s. 6d. c.i.f. for Cubans. Business has also been done in San Domingos at 17s. 9d.. and No. 17 Cubans at 20s. 1½d., Mauritius Crystals from 21s. 9d. to 22s. c.i.f., and Peru 96 per cent. from 19s. 6d. to 19s 9d.

The demand for Refined in America continues to be active and raws have advanced 3½ to 4 cents c.i.f. New York while the Futures Market has followed in sympathy.

The Cuban crop is now practically finished and the final out-turn will probably be 4,055,000 tons.

The European Beet crops are progressing satisfactorily and the size of the roots in most countries is considerably larger than last year although the sugar content is not so high. However, provided there is sufficient sunshine in September, the most sanguine estimates should be reached.

21, Mincing Lane,
London, E.C. 3.
September 5th, 1924.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL

SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 310. OCTOBER, 1924. Vol. XXVI.

Notes and Comments.

The Beet Sugar Movement in England.

It only wanted sufficient fiscal encouragement and the promise of the Labour Government's support, for the beet sugar movement in this country to bound forward. The halting nature of previous movements was invariably due in the main to the inability of Capital to see a clear course ahead. So long as only one of the three great political parties in this country had blessed the principle, it was not surprising if capitalists hesitated to risk their money on so expensive a project as a modern beet sugar factory. But the Labour party have realized their duty towards agriculture since they have come into office, and Mr. Snowden's method of subsidizing the beet sugar industry, though it is open in theory to criticism on the part of economists, is nevertheless unquestionably effective as a *modus operandi*. And it has only needed this assurance of support from one other great party in the state for beet sugar factory schemes to be divised right and left all over the country.

It may be said that there are two main groups at the back of these schemes, the Anglo-Scottish Beet Sugar Corporation with headquarters at Glasgow; and an Anglo-Dutch group of which Mr. Van Rossum of Cantley is the head. We understand they will work in a spirit of co-operation and avoid all competition in the matter of selecting spheres of operations. There are however other bodies, to judge from the press reports, who are at the back of particular factory schemes. So long as these are properly backed and financed, it will be all to the good that the experience going into the new ventures should be as widely cast as possible; and, as we have already urged in a previous note on the subject, we should like to see the best methods of each beet sugar region of the world, including the United States and Czecho-Slovakia, tried out in this country, so that the data on which to base our ultimate standard practice shall be as comprehensive as possible.

But there must be no senseless competition for the working of particular districts. The British Sugar Beet Society with the full concurrence of the Ministry of Agriculture has issued a timely warning against any such congestion in factory building, as all Continental experience is towards concentrating work in one large factory and closing other factories working in the same district. The

Society lays it down that no two factories should be less than 50 to 60 miles apart by rail, in order that there may be available to each factory a working area for sugar beet cultivation within a radius of 25 to 30 miles. This is sound counsel and comes at the right moment for its application.

On another page we give particulars of the latest schemes that are being mooted in England. But Scotland too is experimenting; and under the aegis of the Anglo-Scottish Beet Sugar Corporation some 200 acres of beetroots spread over practically every farming district in Scotland are being cultivated this year in order to ascertain the most promising areas for this industry. The roots so grown will, we gather, be sent by rail to the Nottingham factory of this Corporation. The best results so far achieved have been on the East Coast of Scotland and the Moray Firth, whereas Ayrshire, the home of the early potato, produces rather indifferent results. The Stirling area is productive enough to warrant the first Scotch beet factory being erected there if sufficient beet acreage can be guaranteed. It has to be observed, however, that agricultural authorities in Scotland are not yet unanimous as to whether the beets could stand the rigorous climatic conditions of that country. It may be assumed that sufficiently prolonged tests will be made to settle this point, ere a factory is definitely established; but the climatic objection has been raised before in respect of England only to prove unfounded. Scottish experience may prove it equally unfounded as regards the northern kingdom.

The Political Situation.

However, it has to be remembered that the Labour Government's policy towards the beet sugar industry at home has yet to be passed into law. Mr. SNOWDEN, when he made his announcement in July, undertook to pass the necessary legislation during the autumn session, when the House of Commons would have had an opportunity to discuss the details.

Unfortunately for the industry a political crisis has intervened, and the third General Election within two years is now a matter of only two weeks ahead. The Labour Government, the second largest party in the House of Commons, has been in office for nine months solely by virtue of the fact that the Liberals refused to combine in any way with the Unionists to allow the latter to get a working majority, and being unable themselves to form a stable Government preferred to put the Labour Party in as a stop-gap shorn of all real power. Having done that they found, as might have been expected, that they must either support Labour against the Unionists or else see Labour defeated and appealing at the polls for increased support on the part of the electors. Liberalism nowadays is decidedly at a discount throughout the country, so that this party has all along been faced with the alternatives of either supporting a Labour and Socialist policy it hated or precipitating another election at which its candidates might suffer a further eclipse. For nine months they have as it were marked time, but it only needed a characteristic piece of Socialistic policy on the part of the Labour Government to force the Liberals to combine with the Unionists for the purpose of defeating the Government. The particular policy was the interference of the Government from political motives with the course of justice when a prosecution of an editor for preaching sedition was started and then withdrawn. Apart from this there loomed in the background an indictment against the Government for a treaty with the Russian Communists that was too reactionary to be tolerated. Either challenge was bound to defeat the Government in the House of Commons, and since the first one effected that object and the Government have decided they cannot accept the consequences, they are dissolving Parliament and appealing to the country in the hope that the electorate may send them back to Parliament stronger than before. So, as indications point at the moment of writing, a new Parliament will be in existence before our next issue is out.

The commercial life of the country will greatly resent the intervention of a third election within two years ; that elections disturb trade goes without saying. But trade would gladly put up with all the interruption and disturbance if it could be certain that the result would be the return to power of a constitutional government. A Liberal Government (save as a minority party with all the disadvantages that that entails) there is not the least chance of establishing. A Unionist Government has a greater chance of obtaining a working majority ; but everything depends on how far they succeed in coming to an understanding with the Liberals to avoid splitting the constitutional vote at the polls and thereby letting a Labour candidate in. There is no room for three-cornered contests in the present state of politics; and the chances of the country securing a good Government lie very largely in the extent to which these vote splittings are eliminated.

As far as the sugar industry is concerned, the present Government has one good thing to its credit and another to its discredit. Its support of the home beet sugar industry was creditable, and if it returns again to power we have no doubt Mr. SNOWDEN will make good his promises. The whittling down earlier in the session of Imperial Preference for Empire sugar was a disgraceful piece of political obliquity; and we suspect that after further investigation of the problem of supplying this country with sugar, Mr. SNOWDEN was not quite so confident that he had done the right thing. His subsequent attitude towards the question of preference to home-grown sugar marked him out as an obviously recent convert. And he confessed to the impeachment.

If the Conservatives come back to power again it may be expected they will honour Mr. SNOWDEN's undertaking to the industry. But if a minority government of Liberals in its turn comes into office to mark time, it may be assumed that they will not readily grant any facilities for the passage of a piece of legislation which when mooted last July they so vehemently denounced. However in another month the country will know where it stands and what sort of Government it is going to have for another year or two at least.

The Control of Sugar Cane Diseases.

There are certain aspects in the work of controlling sugar cane diseases which we have not seen to be so strongly emphasized elsewhere as in a recent pamphlet written by D. S. NORTH of the Colonial Sugar Refining Company, who has commenced an attack on the diseases in the Australian cane fields; and we would refer our readers to a précis of this paper elsewhere in this number of the Journal. There is, it is true, nothing startling or subversive in the methods which he advocates, but the point of view differs radically from much that has been written on the subject. The work on which he is engaged is a purely domestic matter of the Company, and is of an intensely practical character; and is of such a detailed nature as would be quite impossible for the diffused energies of such officers as could be offered by any Government agricultural department to any particular industry. And the result is that no more striking example could be given of the importance for the major tropical planting industries to run their experiments with their own resources and on their own lines. The acid test of such work is economic and, although this aspect never obtrudes itself in the paper, there is no doubt left in the mind after reading it that the Colonial Sugar Refining Company regards the whole business as closely connected with profit and loss in the mill. To some the views expressed by North may be disconcerting, but they will appeal to all experts working in the fields on cane diseases, even if they are not in a position to translate them into practice; it is only where the industry takes upon itself the care of its fields, notably in Java and Hawaii, that this can be the case. The basis of the whole scheme unfolded is the house to house visitation of each estate and the close study of every field, details of which are kept in such "field books" as are usually maintained on experimental stations; and the results recorded of this intensive study are quite remarkable. The work is not rendered any easier in Australia, because the mill has usually no control over the cane cultivation, as the vast bulk of this is in the hands of petty farmers. The task requires peculiar care and tact, and the way in which the value of the work is being brought home to the individual farmers, of which some details are given in our article, is highly instructive; no such work could be done without the closest co-operation between mill and plantation, and this is being secured by appropriate means.

Taking as a basis the losses incurred in the fields supplying cane to one of the Company's mills, where intensive study conducted for several years has made it possible, by an analysis of the cane books, to form an estimate of damage caused by four major diseases, North lays it down as a conservative estimate that every year £100,000 is lost by diseases in the Australian cane fields. He claims that there are probably more such diseases in Australia than in any other country; and, as the industry is a new one and no one of these is at present put down as endemic, he explains this long list by the unrestricted importation and dissemination of the varieties from other countries, of which New Guinea is regarded as most guilty. He points out that varietal plots are in the main the source from which diseases are spread in any country, giving cogent examples in support of this; and this being the case he would interdict any further introductions for a time at least, and rely on seedling work for the supply of new forms as are needed in any cane industry. Quarantine is fully discussed and he gives the regulations which he considers necessary for such a course to be rendered effective and which he has put into practice himself. Some of these points are dealt with in our review of this paper, and we think that all who have not read the pamphlet may find it worth while to refer to our summary of some of North's proposals, all of which are based on his own practice in his successful fight against the Fiji disease in the island of that name.

Ourselves and Mr. Rosenfeld.

With regard to the correspondence which has taken place in our pages in consequence of the paper written by Mr. Rosenfeld on "A Beneficial Aspect of the Sugar Cane Mosaic Disease,"[1] we have received a further long letter from him, which we regret that we are unable to find space for, as it deals mainly with the point of view as to the present conditions of the cotton growing industry in the United States. In brief, Mr. Rosenfeld in this letter commences by taxing us with not having given him credit for his appreciation of the losses incurred by plant diseases, and also with having assumed an acrimonious attitude in our note on his letter on page 380. This was far from being our intention, but we naturally had to clear ourselves of the charge of a "most deplorable lack of knowledge of the cotton growing conditions in the United States to-day." We are sorry that in doing so we should have said anything to lead him to consider our attitude as personal. We, as Editor, are perhaps impersonal, but we took no offence at Mr. Rosenfeld's, to say the least, *critical* remarks; and, after giving the authorities for our statements, merely threw the ball back again! The rest of the letter is a rather intricate argument with much that is controversial, and we fear that it has not made us alter our standpoint: we are unrepentant, we think our authorities incontrovertible, and now must leave the matter to the judgment of our readers.

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[1] *I.S.J.*, 1924, pp. 191-5, 180-1, and 380-3.

International Commission for Methods of Sugar Analysis.

Dr. H. C. PRINSEN GEERLIGS, after recounting the reasons that led to the formation of the International Commission for Uniform Methods of Sugar Analysis, and the nature of the work which it has accomplished, recalled recently[1] the valuable services rendered by Prof. Dr. HERZFELD, who previous to the war was elected permanent President. He pointed out that, as the result of the events of the past ten years on international relationships, it has not been possible to unite members in session, although subjects for discussion (such as the 100° point of the saccharimeter, and the constant of the double polarization method) are not lacking. He expressed the hope that in the near future in one of the European or American capitals a meeting may again take place; and he at the same time expressed the hope that Prof. HERZFELD may be able and willing to take the Chair. Dr. PRINSEN GEERLIGS stated his belief that the surviving members of the Commission would willingly unite with new members under the presidency of Prof. HERZFELD for the discussion of several questions, the settlement of which is now very desirable.

But to Dr. Geerligs' remarks the following statement of the position may be appended: British, French, Belgian and apparently also American and Czecho-Slovakian chemists, much as they respect the scientific eminence of Prof. HERZFELD, find themselves unable to take part in a meeting under his presidency, which high office, however, he persistently refuses to resign. As a possible way of circumventing this deadlock, British chemists in 1920 suggested that Dr. GEERLIGS should be invited to re-organize the Commission under his presidency, having come to the conclusion that "the best arrangement possible for all the nationalities concerned would be to agree to the transfer of the headquarters of the Commission from Berlin to Amsterdam" under this eminent Dutch chemist's direction. At the time nothing definite was accomplished in realizing this suggestion, Germany, France and Belgium being the principal dissenters. However, we express the earnest hope that now a more reasonable and conciliatory attitude may prevail among the various parties concerned, and that in the near future the Amsterdam scheme may be accepted as one agreeable and convenient to all.

How the Sugar is Consumed in the United States.

According to an American paper,[2] not more than half the sugar eaten in the United States is domestically consumed. The rest goes into manufactured products. The candy makers alone use more than 350,000 tons, while 130,000 tons go to sweetening up chocolates and ice creams. Bakers take 45,000 tons for bread, 55,000 for crackers, and 90,000 tons for pies and cakes. Some 10,000 tons is used in frostings and odds and ends in the bakeries. The "soft drink" manufacturers use up some 135,000 tons per annum, while 100,000 tons goes into condensed milk. Chewing gum accounts for 20,000 tons, chewing tobacco for 15,000 tons, and smoking tobacco for 6000 tons. Pharmaceutical preparations absorb 6000 tons, while prescriptions at the chemist take an unknown quantity.

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[1] *Die deutsche Zuckerindustrie*, 1924, 49, No. 36, 1032-33.

[2] The *Nation's Business*, quoted by the *Cuba Review*.

Nothing is said, however, as to the amount of sugar used in the fruit canning industries, and as the amounts cited above barely total one million tons, or 20 per cent. of the American consumption, we are left in the dark as to the remaining 30 per cent. which makes up the half which, we are told, goes into manufactured products. Still, the figures are interesting as showing the widespread use to which sugar is put.

Molasses Syrups.

The United States has a considerable export trade in glucose, table syrups and molasses, which has been fairly consistent during the last 15 years. At present the United Kingdom, Scandinavia and North West Europe are the best market for these exports. It is roughly estimated, according to an American commerce report, that in the United Kingdom about 75 per cent. of the imports coming in under the heading of molasses and syrups, are of molasses for distilling and for the production of feeding stuffs, and 25 per cent. are syrups for table use. The principal demand for molasses is of the "blackstrap" variety. This is shipped in barrels and is sent directly to distillers and to foodstuffs manufacturers. British imports of table syrups have increased since the war, although maple syrups and corn-syrup blends are as yet not very popular. The pure cane syrup or the refiners' blends are preferred. The favourite syrup package is the can in one-half pint and pint size. Bottled syrups are rarely seen.

In Sweden golden syrup is preferred to other kinds ; but a clear light article of high grade, and dark syrups of good quality will find a good market. The import regulations are very strict with regard to syrups, and a careful study should be made of the ordinances on the subject before entering that market.

In Norway the consumers lay particular stress upon the colour of the syrup. The percentage of sugar must not be over 70 per cent. nor of glucose over 25 per cent. Very quick syrups, the lighter in colour the better, are preferred for table use, but some dark syrups are liked for use in baking and for candy making. English syrups are keen competitors in the Scandinavian market. Syrup is imported in barrels or in tins in both Norway and Sweden. In Denmark table syrups form the greatest part of the imports. The preference is for the golden-brown variety, containing about 80 per cent. solid matter. Absolutely first-class syrup is required, and in the past the effect of putting poor grades of syrup on the market has been to decrease the imports and to injure the possibilities of the market.

Production in Italy.

The *Circulaire hebdomadaire* states that for the coming campaign the Italian beet sugar industry will have eleven new factories in operation, while in addition there are five more projected for the 1925-26 season. This increase in manufacturing capacity will allow Italy to slice 48,000 tons of beet per day, of which 8000 are provided by the new factories.

Some Italians hold the view that their industry ought not only to produce the sugar needed for indigenous consumption but should also develop an export of sugar. This view is contested by an Italian sugar publication[1] which fears that if this plan were carried out disillusionment would follow. If the world's price fell below the cost price of production in Italy, production for export would cease to be a paying proposition. And the feeble sucrose content of Italian sugar beets, which is supposed to be an outcome of the climate, places Italian production at a disadvantage as compared with other beet sugar producing countries.

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[1] *Boll dell'Industria saccarifera Italiana.*

The development of the Italian industry, in the opinion of the above quoted publication, should be kept within the limits of the indigenous consumption which is round about 320,000 tons. Last year 39 sucreries produced 315,000 tons without forcing production. It is obvious then that the new factories are faced by the alternative of either depriving the older establishments of an important share in furnishing the home consumption or else of selling their surplus production for export. It is true that the consumption in Italy is capable of increase. During the last decade it has risen from 4 kg. to 7½ kg. per head and there is yet a margin for further expansion. The factories can thus count on an increasing market at their doors which would go some way to counteract the dangers arising from over-production when the world's market is not in a condition to justify Italian export of surplus sugar.

In Italy the cost of transporting the roots is very high. It is advisable to concentrate the factories in the districts where the production of beets is intensive. The large increase in the surface sown to beets the last few years is due to the high price of sugar which has permitted payment to the farmers for roots on a higher scale than for other agricultural products. If a lower price of sugar at any time forced a reduction in the scale of payment for roots, the cultivation of beets would diminish to a degree that would leave the sucreries insufficiently provided for. It is therefore probable that the economic limits of expansion have been exceeded by the erection of new factories, and steps will have to be taken to arrest further developments if a crisis is not to ensue in the Italian sugar industry.

The Egyptian Sugar Industry.

In a recent Department of Overseas Trade Report on the economic situation in Egypt, as prepared by the British Commercial Secretary at Cairo, we are told that the first Egyptian Cabinet to be responsible to a Parliament has so far shown itself strongly in favour of extending Egypt's industrial activities, whether promoted by European enterprise or not, and contemplates the formation of a consultative body to study industrial problems.

As regards the sugar industry, official control over it was terminated in May, 1923, and this opened the door to unrestricted importation of foreign competitive sugar, both raw and refined. On October 25th, 1923, an excise duty of 2 per cent. *ad valorem* was imposed on all sugar whether of Egyptian or foreign origin subjected to any operation of refining by mechanical processes in Egypt, and the *ad valorem* import duty on refined sugar was raised from 1 per cent. to 10 per cent. (Sugar from native factories which employ no mechanical power and supply purely native requirements of molasses is exempt from this excise tax.) In the event of the export abroad of sugar refined in Egypt, the excise duty is refunded subject to formalities which take some time to complete.

Actually in the remaining eight months of 1923, following on the removal of the control and prohibition of imports, the importation of raw cane sugar, all from Java, rose from nil in 1922 to 2820 tons in 1923; beet sugar chiefly from Czecho-Slovakia from nil to 1316 tons; and refined cane sugar mostly from Great Britain from 145 to 405 tons. An increase in sugar exports was also registered, refined cane sugar increasing from 13,126 tons in 1922 to 37,550 tons in 1923, the largest share of it going to Great Britain, with lesser quantities to Mesopotamia, Palestine, French Mediterranean possessions, and British India.

It would appear then that the freer market for sugar in Egypt has not resulted in any diminution in the indigenous production and its export.

The Beet Sugar Industry in England.

Progress of the Movement.

Mr. Alfred Wood, F.C.A., speaking before the Rotary Club at Nottingham last month, made the following statement on behalf of the British Sugar Beet Society.

"It is understood that the Government will introduce a Bill as early as possible during the Autumn Session to give effect to the subsidy proposals announced by the Chancellor of the Exchequer during the Unemployment Debate on the 30th July last. These proposals are retrospective, that is to say, affecting the beet crops now approaching the period of harvest and the sugar manufacturing season commencing in October.

"The immediate effect of the Government's policy will be to broaden the basis of experience and education in this new industry in which Great Britain is several generations behind other countries. The number of beet sugar factories, at present three, namely, Cantley, Kelham and Colwick, is to be increased to nine by the end of the year 1926. The six new factories have been undertaken by responsible groups with the necessary financial and technical backing, and the Society has information to show that these promises to the Government will be honourably fulfilled. They are of course conditional not only to the passing of the necessary legislation this Autumn but also to the loyal support of the farmers themselves. The first of these factory schemes, for instance, at Ely in Cambridgeshire, is to be started forthwith, as the necessary minimum of 5000 acres of beet has already been definitely guaranteed and further contracts to a total of 10,000 acres are being offered. Expenditure involving £300,000 to £400,000 for each factory, with provision for an additional £80,000 to £100,000 for working capital (including advances to growers on growing crops) is a serious matter, and cannot be entered upon unless a regular and permanent and not a spasmodic supply of raw material is assured to the factory.

"The principal object of the industry is to encourage arable cultivation and thereby to increase the production of cereals, with the consequent additional employment upon the land. The burden of risk, it is to be noted, falls upon the sugar manufacturer. Every reasonable encouragement to the grower is given. The world prices of sugar cannot be stabilized, yet during the period of the 19s. 6d. subsidy the manufacturer is to guarantee to the grower a minimum price of 44s. per ton of beet, throwing upon the manufacturer all risks in the fall of sugar prices below 28s. 9d. per cwt. On the other hand the existing sliding scale contract gives the grower a share in increased receipts by the factory for its sugar, so that the operation of the subsidy proposals at their commencing rates will give the grower with a period contract 11s. 2d. more per ton of beet than the price to which he would at present be entitled. If the prevailing world prices of sugar are maintained the grower will receive approximately 55s. for each ton of beet he produces on the basis of 15½ per cent. sugar content or about 20s. more than the price paid last year in any other country in the world."

Price for roots.—The British Sugar Beet Society has received many enquiries with regard to the effect of the Government's proposals upon the price of beets to be supplied to the factories under existing contracts between the growers and the manufacturers. Under these contracts the grower receives for each ton of beets of 15½ per cent. sugar content (with an addition or deduction of 2s. 6d. per ton for each 1 per cent. of sugar content above or below 15½ per cent.) a sum equal to the average receipts of the factory per cwt. of sugar produced. If, however, he has contracted for a period of years this price is increased by one-seventh, the large majority of growers being under contract for three years.

If legislative effect is given this autumn to the Government's proposals, the price for beet, being based on net factory receipts, will be automatically increased by 11s. 2d. per ton, that is to say, the difference between 19s. 6d. and 9s. 9d. with the addition of one-seventh. The following comparative table may serve to illustrate the effect of Mr. Snowden's proposals upon the beet contract:—

	PRESENT PRICE		NEW PRICE.	
Average Sale price of Sugar per cwt.	Add one-seventh for Period Contract.	Price per ton of Beet.	Addition to price.	Price per ton of Beet.
£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1 18 0	0 5 6	2 3 6	0 11 2	2 14 8
1 14 0	0 4 11	1 18 11	0 11 2	2 10 1
1 10 0	0 4 4	1 14 4	0 11 2	2 5 6
1 6 0	0 3 9	1 9 9	0 11 2	2 0 11

New factory projects.—Three factories are to operate in this country during the coming slicing season. Cantley in Norfolk, Kelham in Notts, and Colwick[1] also in Notts. Of the six new factory schemes referred to by Mr. SNOWDEN in the House of Commons,[2] the first is now announced as being in the Ely district of Cambridgeshire. This is to be run, we gather, by the Van Rossum or Anglo-Dutch group which controls Cantley. A suitable site has been selected and as soon as the necessary beet contracts are completed, building operations will be put in hand.

Another of the six, for which the Anglo-Scottish Sugar Beet Corporation are making themselves responsible, is projected in the Spalding or Bourne district of Lincolnshire. The Spalding Corporation are anxious to have it erected within their area and if a suitable site is found, the scheme will go forward; failing Spalding the Bourne district will be tried. Other projects reported in the press include: a factory at Wissington in Suffolk to be run by a syndicate called the All-British Sugar Beet Company, of which Mr. TOWLER, a large landowner is one of the moving spirits and Messrs. John McNeil & Co., Ltd. of Glasgow are said to be providing the factory equipment; Manningtree, near Colchester in Essex, where a site on the river Stour has been found, to be promoted by the British & Allied Investment Company; and Bury St. Edmunds where Mr. SCHRAPRINGER is bent on floating a company to produce beet sugar. All the above projects have been in negotiation with the local Farmers' Unions with a view to getting a guarantee of beet supplies.

Besides the above, it is apparent that other parts of the country are interesting themselves in the new movement, and one learns of preliminary spadework at Peterborough (where the authorities are pressing the Anglo-Scottish group to erect a factory), in Cornwall, in East Sussex, and in the north west corner of Lancashire; while in Scotland the Anglo-Scottish Beet Corporation are carrying out field trials to test the suitability of that country to grow beetroot in average weather. Finally, the Kidderminster project already referred to in these pages[3] will now probably go forward, as its only obstacle—a financial one—is sure to be overcome.

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[1] See *I.S.J.*, 1924, 458.

[2] *Ibid.*, 1924, 407.

[3] *I.S.J.*, 1924, 394, 507.

Sugar Cane Diseases in Australia and their Control.

One of the greatest differences between insect pests and fungus or other diseases in crops lies in their relative obviousness; and thus, although the control in each case has its own difficulties, the study of the former is popularly regarded as easier and appeals more readily to the amateur naturalist, doubtless also attracted by the lure of form and colour. The economic entomologist is, so to speak, continually working in the light, and there is something definite to attack; the relative scarcity or disappearance of a pest may be safely regarded as a test whereby he can judge of success or failure. There are, of course, considerable fluctuations in the numbers of insects present from season to season, and the sudden increases and decreases in nature cannot always be satisfactorily explained without careful study. Matters are very different with diseases. They are mysterious in that their causes are largely invisible; there is no well-defined limit between health and disease; fungi may be present without apparently causing any inconvenience to the plant, and virulent diseases are often met with in which no trace of any causative organism has been found. Thus, while the amateur may often succeed in the control of insects, he is hopelessly at sea with diseases. This branch of phytopathology is, in fact, not open to the layman and the expert has to be called in. Some forms of fungi have been found to be of great importance to the growth of plants, and if they are not present in the tissues such plants cannot exist. We then speak of a symbiosis or living together of plant and fungus. Others live only on decaying vegetable matter, and are known as saprophytes; they cannot injure healthy plants, although they are often charged with so doing. A more insidious series is included under the term weak parasites, in that they can only attack plants in an enfeebled condition; here again they are often thought to be the direct cause of a disease, whereas they are only of secondary influence. Lastly, the true parasites are such as attack and destroy healthy plant tissues; but, from the crop point of view, even in this class there are all stages between what are considered dangerous diseases and merely negligible markings. Perhaps an example may show how easy it is to be misled in judging the true cause of an epidemic outbreak in the cane fields. In the early nineties a severe infestation of the canes in certain West Indian islands by a minute beetle called the shot borer was viewed with grave concern, as all canes thus attacked prove to be worthless from the sugar point of view, and whole fields rotted away when full grown. Apparently nothing could be done beyond noting that certain varieties were very much less attacked than others. But a little observation showed that a fungus was also present in these canes and that the shot borer was preceded by it; the minute beetle was to all appearance attracted to the canes by the strong vinous smell of the decaying sugary contents of the cells. This disease came to be called the "rind disease," and was thought to be a dangerous menace to the industry. But in the hands of mycologists the fungus causing the obvious eruptions on the rind was proved to be a very weak parasite, if not merely a saprophyte, and another fungus was found to precede it which worked more deeply in the tissues and gave them characteristic red markings, and thus earned for it the name of "red rot." The fungus causing these colorations was thoroughly studied in the laboratory, and by degrees it has come in recent years to be considered, after all, to be a weak parasite itself, and its ability to attack the canes to be dependent on some other cause which left it an enfeebled plant incapable of resistance. We now know that under certain cultural conditions the fungus producing red rot is incapable of doing any harm.

Presumably, if this was true at that time, the real cause of the outbreak in the nineties is to be sought in some form of "root disease," which is still being debated and studied all over the world. It is obvious that here we have a subject entirely beyond the ordinary cane grower, and the study and control is, in the first instance, for the mycologist, with his powerful microscope and manifold culture apparatus; for it is held to be a first necessity, in definitely charging a fungus with causing a disease, of making suitable cultures of the fungus, and producing the disease in healthy plants by inoculating them with portions of the fungus under suspicion. And the whole question is further complicated by the undoubted fact that the degree of parasitism of any fungus is not a fixed quantity; in certain fungi comparatively harmless forms may develop active attacking powers, while the parasitism of others gradually varies, until they come to be regarded as more or less negligible. Into that aspect of the question we cannot enter here.

It is thus not surprising that the study of the insect pests of a crop usually precedes that of the fungus diseases, and this has been markedly the case in many sugar cane countries. We have heard a great deal about the cane pests in Queensland, and during recent years many summaries of the interesting work of fighting the white grub, weevil borer, and so on have been presented to our readers, but little has come our way regarding the diseases of the cane—whether there be a mycologist attached to the agricultural department or not. It is therefore with great interest that we have read a recent pamphlet[1] by D. S. NORTH, of the Colonial Sugar Refining Company, dealing with the whole subject. From this paper we see that things are not as they should be in the fields, in fact that an alarming state of affairs exists; and we are glad to learn that this officer, already known by his successful work in fighting the Fiji disease in the island of that name, has commenced to work on various cane diseases in Australia. It may be noted that this work is entirely without any Government aid, and is of course concentrated on the fields belonging to the Company, but there is no disadvantage at all in this, and co-operation is invited with any Government institution in the campaign now being started. NORTH's conclusions and methods are not altogether usual, being in fact much more fundamental than any agricultural department could undertake, an additional support for the plea that we have often expressed that this class of work should be done by the planters themselves if the best results are to be obtained. The following notes extracted from this long paper will give some idea of its contents.

The author records the fact that, when the Fiji disease of the sugar cane appeared in that island and threatened the industry with extinction, it was attacked by the Colonial Sugar Refinery Company's officials, and in three or four years so brought under control that it is at present no longer feared to any extent. He proposes to introduce the methods employed into Australia, and to apply them to other diseases, which a preliminary survey during 1910-15 has shown to be widely spread. This survey was made by the staffs of the various mills owned by the Company, and as a result it is considered that there is a longer list of important cane diseases in the country than in any other. This the author refers to the unrestricted importation during the past fifty years of multitudes of cane varieties from all directions, without attention being paid to the possibility of at the same time introducing their prevalent diseases. Thus NORTH explains the fact that, while no cane disease is at present considered to be endemic in Australia, the cane fields harbour the great majority of those of other countries, besides possessing a formidable list of peculiar forms, chiefly introduced from New Guinea. While sereh, iliau and smut have not as yet been noted, gumming, mosaic, red rot, and rust probably arrived before any canes from New Guinea. Of these mosaic and red rot occur in practically all sugar cane countries and rust in many, while gumming was long ago recorded in Brazil and Mauritius. Fiji disease, leaf scald and leaf stripe have recently appeared in other countries and New Guinea is suspect, although it has only been proved to be the source of the first named. Top rot, curly top, knife cut and various root and leaf diseases have occasionally burst out in severe form, but have not been investigated; and a host of fungi attacking the root, leaf, leaf sheath and stem have probably also arrived from New Guinea. It is, in fact, surmised that still more serious cane diseases may occur in the unexplored parts of that island where also finer varieties of cane are likely to be found, than any as yet introduced into Australia. Having thus dealt with the way in which the cane diseases have come into Australia, the author points out that their dissemination throughout the two thousand mile sugar tract has been very thoroughly effected, in that practically every cane variety of any value has been introduced into every mill area, again without any proper disease control.

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[1] "The Control of Sugar Cane Diseases." D. S. NORTH, Plant Pathologist to the Colonial Sugar Refining Company. Agricultural Report No 6, Sydney, June, 1923 (47 pp.).

The first step taken in this new campaign was the opening, at Broadwater on the Richmond River in New South Wales, of a laboratory to make a study of leaf scald, but in the next year the study of three other major diseases was added, namely, leaf stripe, mosaic and gumming, and the staff at the laboratory was increased to four. Further extensions are already in progress to other tracts where the Company owns sugar cane mills, but as is pointed out such extensions must of necessity be slow because of the scarcity of trained men. It is wisely arranged that no more work should be undertaken than can properly be brought to some sort of conclusion; and obviously the appointment of a single mycologist—which is all that the Government would be likely to be able to undertake—would be utterly inadequate to deal with the matter at all thoroughly and is not regarded as a reasonable proposition. For, besides the research work which must be done before the diseases are elucidated, there is the much more exacting task of effecting the control of the diseases, which as we shall see will require larger staffs than ever. There is plenty of work awaiting the newly founded laboratory, although, thanks to the studies carried out in Fiji for some years, considerable progress has already been made. The present paper, which may be regarded as of an introductory nature, will it is stated be immediately followed by one on leaf scald and gumming; and later on bulletins will be prepared, one on each of the diseases studied, as results accumulate. We are also promised a paper on the raising of seedlings and the study of varieties by the Agriculturist of the Colonial Sugar Refining Company; and all of these should provide interesting reading and containing new light on many points not as yet being thoroughly cleared up.

For working purposes, the author classifies the Australian cane disease under three types, prefacing this section by drawing attention to the fact that all of them can be passed on in cuttings, since this has obviously been the way they first entered the country.

Type I.—Gumming, leaf scald, leaf stripe, Fiji disease and mosaic. In all of these, diseased sets hand on the disease. They are also highly infectious and are caused by organisms which are strict parasites, although it is true that some of these organisms have not as yet been detected. Little is known as to the vehicle by which this infection is carried although, as the result of experiments, the soil is definitely excluded. These diseases are incurable, but they all appear to be preventable, and this by two methods, seed selection and eradication. Great importance is attached to the observation of early symptoms, and also the avoidance of using seed from any suspected source. Certain knowledge as to the favourite habitat of each disease has been gained and this is of great use; thus Fiji disease affects rich land while leaf stripe prefers poor: gumming thrives on ill drained lands, while leaf scald is chiefly found on high and mosaic in hilly country. After due selection of the seed from irreproachable sources, eradication will cut off the remaining supply of the disease organisms. Where however the infection is widely spread this method is impracticable for economic reasons, and in that case the introduction of resistant varieties becomes invaluable.

Type II.—Red rot, root disease (Marasmius type), sclerotial leaf sheath disease, and probably top rot, curly top and pineapple disease. Parasitism in the fungi of this type is weak, especially in the last three, and only enfeebled plants can be attacked. The fungi can remain in the soil for long periods, coming into prominence in unfavourable seasons, while under good growing condititions the cane plants appear to be immune. The diseases can be handed on by cuttings but are not incurable, as perfectly healthy plants may be raised from diseased cuttings if suitable conditions are provided. Seed selection and eradication are of secondary importance and the main lines of control are good cultivation, a suitable rotation, and the growth of resistant varieties (itself a form of rotation, although such varieties are usually inferior to those temporarily displaced).

Type III.—Leaf spots such as rust (true rust caused by a fungus), eye spot, ring spot. The fungi causing these diseases are strict parasites as in Type I, but are not sufficiently harmful to need control measures. They usually appear only at certain times of the year, e.g., in winter. Great care is however desirable in getting to know these and other leaf markings, for each of the serious diseases in Type I has its own peculiar form, which should be thoroughly understood.

With regard to the importation of varieties, the author naturally contends that, in Australia, this should receive first attention; and it is not difficult to gather that he favours more thorough going precautions than are usually considered necessary. He makes a good case that these introductions have been the prime cause for all the Australian cane diseases having entered into the country; the industry is young and yet practically all the cane diseases of the world have been collected in it, and the free distribution of cane varieties in the cane belt itself has spread these diseases to the remotest corners of the tract. He gives well authenticated cases where, even under the closest expert supervision, serious pests and diseases have been sent in the cane cuttings, even when examined both before sending and after receipt and declared to be sound. Further, certain diseases have been demonstrated to be capable of lying concealed from the most careful scrutiny, especially in such forms as leaf scald and gumming; and apparently they may remain, so to speak, latent for a considerable period, cases being given where leaf stripe remained latent for over a year and leaf scald for eight months after being sent off. A consideration of such instances has led in the past to making use of natural barriers between the introduced canes and the plantation fields, e.g., by first planting them on a neighbouring island, behind a high mountain range, or at a great distance from the interested cultivation. But this form of quarantine is not always available, and in certain countries any form of quarantine is distrusted and total prohibition has been passed by law, as in the

United States and Hawaii, a plan of action which the author appears to regard with distinct approval.[1]

He points out that any collections of varieties are in themselves dangerous as a possible source from which diseases may be spread: the larger the Institution and the greater the number of different forms collected, the greater the danger. In support of this he mentions undoubted cases, in which serious diseases have been disseminated from such collections made by Agricultural Departments, in spite of the supervision of the local experts. Diseases he states are always more in evidence where several varieties are grown than in plantations with only one or two kinds of cane, and this he applies to the case in point. His explanation of this somewhat startling statement is that the varieties that are thus brought close together vary greatly in their respective resistance to different diseases. A fairly resistant form may be the carrier of a disease not in itself harmful or conspicuous, but when less hardy forms are placed near to it they inevitably contract the disease with disastrous results. Summarizing, the author remarks that there are two conflicting points of view: one that exotic varieties may be desirable for resistance, sweetness or high yield and should therefore be introduced; and the other that it has been found impossible to guarantee absolute freedom from disease in any importation.

His way out of this difficulty is to rely for new varieties, for a time at least, solely on the raising of seedlings, thus avoiding all the acknowledged dangers of importation. The work of raising seedlings is comparatively easy, although much work has to be done in selection afterwards. But this line has not been followed up to any great extent in Australia, only some 2500 seedlings having been passed through their tests, in comparison with the millions raised in the West Indies, the 20,000 a year which has become routine practice in Java and even the 1-2000 raised every year in Fiji. The Australian seedlings thus far grown figure under the letters HQ when raised by the Colonial Sugar Refining Company, and under Q where derived from work at the Brisbane Acclimatization Society; but even among the small number already produced several are in distinct favour in the plantations, e.g., HQ 426, 5, 77, 409, and Q 116, 873, 970, 1098. Seedling canes are in fact much in favour among cultivators in the sugar belt, and it is obvious that there would be much greater chance of success if such seedlings were raised in the country and that part of it for which they are intended. Recently (1921) the Agricultural Department has taken up this work in the northern Experiment Station at South Johnstone, this locality being chosen because of the comparative failure further south. This lack of success in the south is due in great part presumably to the decreasing frequency of flowering as we proceed towards the colder areas, but NORTH points out that this need not be a bar, as seedlings have now been successfully raised there from arrows sent down from the more tropical regions. The raising of seedlings in different regions of the sugar belt will become necessary, both from the point of view of the climate which the seedlings will have to face and for the limitation of unnecessary transport of varieties from one part of the belt to another, on which the author sets his heart.

As to the stock of parents Australia, it is argued, is already amply provided, and there should be no need to import any new canes for some time to come for this purpose. In connexion with this we may draw attention to a recent remark by the Director of Experiment Stations, that Australia has nothing to fear by a comparison as regards the value of its cane varieties with either Hawaii or Java. In case, however, it becomes at any time desirable to introduce a variety of outstanding merit, such importation might be allowed provided strict quarantine is available. And it is interesting to learn the author's views as to what effective quarantine means.

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[1] By a chain of well placed quarantine stations, this embargo on introductions is being lifted in these places.—C. A. B.

As the subject of quarantine is comparatively new and considerable divergencies of view are prevalent, the author here simply describes the routine practice adopted by the Colonial Sugar Refining Company in introducing new varieties of cane from Fiji and New Guinea into Australia. The trial plots are situated in Sydney, far south of the sugar cane belt, the conditions being fortunately quite suited to the growth of the cane. They are placed in private gardens, and are thus easily kept under observation by the officers of the Company's headquarters. The regulations laid down are as follows:—Only 1–4 cuttings are grown of each variety, and not more than three varieties are grown in one plot; the plots are at least one mile apart and are examined once a month; if a symptom appears of any disease, the variety is promptly dug out, and if gumming or root disease is suggested the whole plot is destroyed; the duration of quarantine has at present been fixed as at least two years, but if there is any set-back by frost or injury, the term dates from that of the set-back. It is recognized that this method is not perfect. While the carrying of disease by implements is safeguarded by disinfection, there is always the danger of transmission on the clothes of visitors. It is not unusual for sugar canes to be grown as a curiosity in Sydney gardens; an attempt will be made to limit this practice, but if this is unsuccessful, the greenhouse method will have to be adopted. All sendings of tested varieties are done under close supervision, and in case varieties are transferred from one mill area to another this is done under strict quarantine conditions.

The work of control has special difficulties in all cases where the canes are grown without mill check, and in the Australian sugar belt cane farming is almost universal. The method adopted at Broadwater, where many diseases occur because of the large number of varieties grown, is described in detail and, as will be seen, consists of co-operative work between the mill experts and the farmers growing the cane. Trained men attached to the factory visit all the farmers from whom canes are received, and discussion is, in the first place, directed as to the source from which they derive their seed cane; the prevailing diseases are noted, the surroundings of the fields and any special factors influencing the cultivation; and assistance is offered in all cases in obtaining sound seed for the fields about to be planted. Every detail which can be obtained concerning each field is entered in a special field book kept for the farm, and it is these field books which are the foundation of all the work. The seed obtained is inspected and the growing plants studied in each field as occasion offers, special attention being devoted to early symptoms of any disease which may appear. A mass of information is thus accumulated regarding every field in the area serving the mill, from which it can be easily determined whether it is or is not suitable as a source from which seed can be recommended. A general classification has thus been evolved which runs as follows:—The field is classed as *diseased*, if a single infected stool is seen, and no cane seed is recommended from it; it is classed as *unsafe*, if within a quarter of a mile of any field which is either infected or has been planted with unsafe seed; but if no diseased stools have been noticed and it has not been planted with diseased or unsafe seed, and there is no ground for any suspicion, it is termed *safe*.

Some difficulty was experienced in 1921 in convincing the farmers of the necessity of these precautions, and the history here unfolded of the ultimate success in doing so is both interesting and instructive. Farmers naturally refused to believe that, where no single diseased stool was seen and where the seed appeared to be perfectly sound, there was any danger in planting it. An analysis was accordingly made of the farmers using the three classes of seed and the results obtained by them. (1) 23 farmers planted 98 acres with "safe" seed; all the fields were at first healthy and the majority remained so, but secondary infection occurred in some situated in infected areas. In one case infection by gumming was clearly traced to the knives used. (2) 28 farmers planted 120 acres with "unsafe" seed; on 17 farms leaf scald immediately appeared and on one gumming; the remainder were free at first but three more were soon added as having leaf scald. (3) 46 farmers planted 214 acres with "diseased" seed; in every case disease appeared right away, although the seed when planted showed no sign of any disease (having been obtained from healthy plants away from any diseased stools). This last case had its effect and the whole of the farmers were profoundly impressed; but, of course, the work has been delayed and in some cases control has become much more difficult.

This control work is thus based on a system of co-operation between the farmers and an expert freely placed at their disposal, and can obviously be regarded as a purely domestic proposition, entirely beyond the scope of any agricultural department. It is too early to calculate the effect of the measures on the basis of canes saved, but the author claims that there is every prospect of a rapid control of mosaic and Fiji disease, whereas that of gumming and leaf scald will be much more difficult (because of the difficulty of detecting them and their greater rapidity of infection). The entertainment of expert advisers by the mill is obviously expensive, and the question arises as to whether it is economically profitable. The detailed knowledge obtained and recorded in the field books has proved to be most useful in estimating the losses incurred by the four main diseases at Broadwater, gumming, leaf scald, Fiji disease and mosaic, and these have been recorded for the two years 1920 and 1921. The details are shown in the following table:—

	1920.	1921.
Tons of cane lost by gumming	2,907	1,688
,, ,, leaf scald	940	2,017
,, ,, Fiji disease	300	220
,, ,, mosaic	1,233	2,586
Total tons cane lost	5,380	6,511
Tons of cane harvested	59,000	70,600

Percentage of loss in canes 9·1 and 9·2 per cent. respectively.

This is regarded as approximately the annual losses which are incurred at Broadwater owing to these four diseases. From other observations made by the officers of the Colonial Sugar Refining Company, it is considered that 5 per cent. would be a conservative estimate of the losses caused by diseases in the cane sugar belt every year. Taking the tonnage on an average as two millions, and the value of the cane at £2 per ton, this works out at an annual loss of £100,000.

C. A. B.

Prof. A. Herzfeld, Director of the Institute für Zuckerindustrie, Berlin, recently celebrated his 70th birthday, and received many congratulations on the occasion from his friends and colleagues in different parts.

Cane Cultivation in Cuba.

In a recent issue[1] attention was drawn to the fact that there are great differences in sugar cane cultivation and economic conditions between the older, western part of Cuba and the more recently opened up lands in Oriente and Camaguey in the eastern half. Since writing thus, an interesting description has been received of the routine practice in the latter portion of the island. This booklet,[2] which is beautifully got up and illustrated, has been prepared by P. K. REYNOLDS, and is due to the enterprise of the United Fruit Company of Boston, whose name is so well known in connexion with the banana trade, but which likewise is deeply involved in sugar production. It owns 90,000 acres of land in Cuba under growing canes, 340 miles of railway and two large factories, capable each of grinding 7000 tons of cane a day, and unitedly of turning out 200,000 tons of sugar in the year. Alongside one of these factories the Company has recently erected a distillery with the most up-to-date machinery for converting the final molasses into alcohol-ether motor fuel. Its sugar interests are not however confined to Cuba, for it owns a large refinery (Revere) at Charlestown connected on the one hand with the general railway system of the country and, on the other, by deep water communication with its own fleet of four modern oil-burning steamers, each capable of carrying 24,000 bags of raw sugar from the two Cuban factories. This refinery produces 4000 barrels of refined sugar a day; and as an addendum a modern fire-proof cooperage plant has been erected, with a daily output of 5000 barrels and 4500 wooden boxes. The claim of the United Fruit Company to be "the best example in the world to-day of a self-contained sugar enterprise" would thus seem to go far towards justification.

The booklet covers much of this ground in its 70 large pages, and is divided into three sections, namely "The plantation in Cuba," "The factory or central in Cuba" and "The refinery in the United States" ; and it is the first of these alone with which it is proposed to deal in the present article. The cane growing is not perhaps typical of the bulk of the Cuban crop, but affords a succinct example of the important but decreasing minority where new lands are still being opened up; and as this is being done with ample resources it is fair to assume that better methods are being employed than are often met with in the eastern portion of the island. As already indicated this description of the plantation in Cuba is cast in a popular vein. The work commences with a brief résumé of the history of sugar from the earliest times, followed by a similar description of the cane plant, with which it is not necessary to deal. Cuba is more fully dealt with and is, of course, claimed as the largest single source of the world's cane sugar supply, which has earned for it the name of the "the world's sugar bowl." The Crystalina variety is by far the most frequently grown, and takes up 90 per cent. of the land under cane ; the raising of seedlings has commenced but is not yet a commercial factor; under normal conditions fully matured canes in Cuba are 12 ft. high, but a maximum height of 20 ft. is occasionally met with.

The author starts the section by commenting on the number and magnitude of the operations to be undertaken in opening up new land for sugar cultivation, which it is justly observed are little appreciated by farmers in temperate regions. The land must be sought out and thoroughly examined by experts, in the first instance as to its suitability for the growth of cane; and when it has passed this scrutiny it has to be surveyed and divided up into sections for efficient handling and the keeping of proper records. Then only can the preparation of the land for planting be commenced. Ample accommodation must be provided for the housing of the army of workers, food supplies and merchandise must be rendered available at moderate prices, hospital treatment provided and the sanitary conditions of the new "town" seen to. Transport facilities have to be arranged on a large scale, the sugar mills erected, and the land got into order, so that in a few years a tropical desert or jungle is transformed into a cultivated tract with a teeming population cared for in every way. Most of these concerns are quite out of the range of operations in ordinary farming enterprise, even in the tropics and much more so in temperate climates.

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[1] *I.S.J.*, 1924, p. 377.

[2] The Story of Cuban Sugar, 1924.

Preparation of the land.—The preparation of waste or forest land has often been described, and is briefly summarized. Trees and bush are cut down, the good, hard timber reserved for building purposes and a certain amount put aside for fuel, and the residue heaped and burnt; what escapes the fire is collected in places to be dealt with when the land is finally cleared.

One point on which emphasis is laid may be dealt with here, and that is the danger of fire, which is considered to be a most serious menace to the crop. To cope with this, when the plantation is laid out, fire lines usually 60 ft. wide are put down at intervals among the fields. These are not however allowed to remain uncultivated, but are usually sown with sweet potatoes or other vegetables, which practice serves a double function. A store of food is furnished for the growing population, and the green vegetation itself acts as a check on a running fire in one section crossing the fire line to another.

The further treatment will depend on the class of land and whether there are many roots and stumps still in the ground, after these have been generally removed. As the canes may grow for a number of generations from the same roots it is important that they should be properly spaced in the first instance. For this purpose on new land lines are drawn along the borders and planting stakes put in at regular distances apart, in the case in point 7 ft. being usually allowed each way between plant and plant. If the land has still many roots implemental cultivation cannot be done, and the planting is done by mattock or simply by a sharpened stake which is thrust into the soil in a slanting direction, and the plant inserted with its end about 2 ins. below the surface. At least 3 ins. of rain should have fallen before planting operations are commenced.

Planting.—It is specially important that good seed should be used in the first instance. Cuttings are obtained from mature cane plants of vigorous growth and free from any marks of pests or disease; the best are obtained from plant canes not over 12 months old. These are cut in the field with two or preferably three joints each, the cut being made at least 1 in. from the nearest joint or node. The upper pieces, under the *cogillo* or immature top, are considered the best, and if the lower part of the cane is much rooted it is rejected. The greatest care is exercised in taking the cane seed from the field to the place of planting, both against the effect of the sun and against any possible knock or injury to the projecting buds; planting should be done not later than three days after cutting.

Where the land is sufficiently free from roots and stumps, and in replanting old fields, implemental cultivation is the rule. Ploughs drawn by bullocks or tractors, or steam ploughs are then made use of. The bullocks are chiefly used for smaller areas not altogether free from roots, but tractors are liable to be held up by these obstructions. For steam ploughs large areas are required; because of the initial expense it is not considered a paying proposition to use steam ploughs on areas under 100 *rosas* (177 acres) in extent, when they are reported to do excellent work. In replanting the distances apart are less, 6 ft. by 6 ft. being usual in the United Fruit Company's land.

Cultivation.—This does not loom large in the description. It is, of course, chiefly done by hoes in new land till the implements can be run without danger, and in replanted land the first weeding is still done by hoes, presumably because of endangering the young plants. Then appropriate treatment by light ploughs or disc ploughs drawn by mules will keep the ground clear and well stirred until the cane plants have grown sufficiently to cover the ground and smother the weeds. Similarly, the question of manuring is not given much attention. This will be natural in new lands, but will need attention when the lands are old; it is however, stated that replanting has not hitherto been favoured, because of the abundance of new lands available. Presumably the land belonging to the United Fruit Company has not reached such a state as to make this matter one of urgency as yet. It is stated elsewhere that, besides the 90,000 acres under cane, they possess also lands for development.

Crops.—Plant canes are cut in 12–15 months but, if spring planted, i.e. in May, they are sometimes cut in April or 11 months old. Ratoons may be cut a year after the previous harvest, and so with second ratoons if the growth is good; but, if the mill is well supplied with cane, the ratoons may be allowed to grow for 14–18 months when much better sucrose is obtained. No exact rule can be laid down, the maturing crops are subjected to the closest scrutiny, and chemical analyses are made to test their ripeness. Besides this, the quantities of cane available and the possibility of providing "standovers" for the commencement of the next crop have to be considered. If the canes remain in the ground too long in the field, extensive suckering is apt to take place; if these are grown long enough the tonnage is increased, but the juice is poorer, and the accumulation of leaves over mature canes makes harvesting difficult, while drying up of the juice may take place.

The number of successive ratoons grown depends on the quality of the soil. On moderate lands 6–8 may be reaped, but on the newer and better lands ratooning may be extended considerably beyond this figure. The heaviest tonnage is obtained from virgin land from which forest has been cut, but the sucrose content there is low. In Cuba 35-50 tons of cane or even more may be obtained from such lands, but the average for the island is only 18–20 tons. When ratoons become too poor to pay, other crops may be grown temporarily or permanently, or the fields may be immediately replanted, according to various economic factors. As before surmised, it appears probable that such conditions have not as yet been reached on the Company's lands excepting in fields near to the factory. In the west and middle parts of Cuba the cropping season usually begins in the latter part of November or early in December, and finishes at latest by June 1st, as the rainy season commences in the middle of May. In the east, on the other hand, grinding generally begins in the latter part of December or early in January and continues till July, or even in a few mills till September—October. In all cases, however, weather conditions must be considered, and this varies from year to year and, in different parts of the island, in the same year.

Harvesting.—The cane is cut in the usual way, and the top severed at the point between the solid cane and the beginning of the soft growing piece, this being easily determined even by beginners. The green tops form the chief food of the cattle during the reaping season, and the residue together with the trash is allowed to lie as a mulch on the ground. Strict supervision is however needed over the cutting and loading, or useless green parts or trash are sent along with the canes, thus increasing the weight paid for and necessitating additional expense at the factory in separating this rubbish from the canes. Harvesting is usually done on the contract basis, the contractor aided by the Central being in complete charge of the labour; but his treatment of the men is carefully scrutinized by the mill authorities.

In the case of the United Fruit Company practically all the carts and half the live stock are furnished by it. The standard of weight and payment is the *arroba* (25 lbs.); and the labour is paid 75 cents to $1 for every 100 *arrobas* of cane cut and loaded on to the carts. The cost of haulage to the railway siding depends on the distance traversed, and ranges from 25 to 50 cents per 100 *arrobas*, but if the cartmen supply the carts and cattle they receive double these amounts. Cane cutting is the most serious problem in the Cuban sugar industry: the mill must run night and day during the season, and the labour in the island is insufficient for the work. No mechanical cutter has as yet proved successful.

The Colono system.—It is the policy of the United Fruit Company to purchase part of its cane from *colonos* or farmers, growing it on their own land or that leased from the Company. It is also the practice to encourage the planting of cane at convenient distances from the mill, the Company usually advancing the money for the raising of the cane and its delivery. The usual contract stipulates that the canes shall be of a proper age and condition, without tops or trash and not fermented, the colono receiving a certain unit or "percentage" based on the weight of canes as determined by the factory scales. This unit varies from 5 to 8 per cent. in different parts of the island, e.g. at 5 per cent. the *colono* receives, for every 100 arrobas of canes he delivers, 5 arrobas of raw sugar or its cash equivalent. The latter is determined by the average price of sugar reported officially from Havana during the week or fortnight in which the cane was delivered. Although some 80 per cent. of the sugar of the island is raised by the *colonos*, the cane used by the two factories belonging to the Company is chiefly obtained from Company or "administration" cane.

C. A. B.

A Note on Gur.

By P. H. PARR.

In the report of the India Sugar Committee of 1920 we read that "gur, gul, or jaggery is cane juice concentrated to solidification without purification, except the addition of a small amount of alkali and the removal of scums. In India, 99 per cent. of the sugar made is gur."

Since the sugar production in India is more than three million tons per annum, the above statement means that, even to-day, nearly one quarter (23½ per cent.) of the total cane sugar production of the world is obtained in the crudest possible form. All of this gur is of course consumed locally, and mostly in the crude form in which it is originally produced, but a certain—and increasing—amount is refined in order to obtain a higher grade sugar.[1] The conditions in India are not generally favourable to the operation of large factories producing a high-grade white sugar direct from the cane, and it appears to be very probable that gur refineries will be fully as important as sugar factories during the next decade. Moreover, since gur will keep, the sugar factories, with the addition of a comparatively small amount of machinery, can be used for gur refining during the off-season.

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[1] For 1922-23, about 3 per cent. of the gur produced in India was treated in the gur refineries, the output of sugar from this source being more than double that from the cane factories.

A Note on Gur.

Although a certain amount of acclimatized tropical cane is grown in India, practically the whole of the cane gur is produced from the indigenous Indian canes; owing to the great variety of these, and the crude and varying local methods of production, the composition of gur is exceedingly variable, which adds very considerably to the difficulty of treating it in a gur refinery. In general, the sucrose content is fairly high, but it is accompanied by an excessive proportion of glucose, organic impurities, and ash, so that the purity is low, and it is by no means a simple matter to produce a high-grade sugar direct from gur, on a commercial scale. As the gur is made in direct-fired pans, burned or caramelized gur is not at all infrequent, and this adds considerably to the difficulty of refining.

In addition to the gur from cane juice, there is an actually large, although relatively small, amount of jaggery produced from the liquor tapped from certain date palms, and this is usually even more troublesome to refine than is the gur from the indigenous sugar canes.

The quality and condition of gur vary to such an enormous extent that definite estimations are quite impossible, and a refinery designed nominally to deal with a certain amount of gur may actually deal with 50 per cent. less or more —the former being the usual experience.

Most of the existing gur refineries have been built up gradually; there is usually but little technical control, and technical information on the subject is conspicuous by its absence; even gur analyses are not readily available, and are usually very incomplete.

A consideration of over 20 analyses of gur from different parts of India shows that the sucrose content varies from 62 to 87 per cent.; the glucose from 5 to 20 per cent.; the moisture from 5 to 15 per cent.; and ash up to 6 per cent. or even more. As the result of a careful study of available data from various sources, the writer considers that a fair average analysis of gur is :—

	Per cent.
Sucrose	67
Glucose	15
Other soluble organic matter	8
Water and insoluble matter	10
	100

so that, approximately, the average gur may be taken as 90° Brix. (per cent. solids) of 75 per cent. purity and 22 glucose ratio. As before mentioned, the variations in practice are very great indeed, but the above figures appear to give a reasonable average.

The simplest method of gur refining is of course merely to dissolve, clarify with lime and heat, filter to remove the mechanical impurities, crystallize *in vacuo*, and separate the crystals in a centrifugal, the result being roughly equivalent to the second sugars obtained in an ordinary defecation factory, which is all that can be expected from a simple treatment, since the dissolved gur is usually but little better than an ordinary first molasses. For a rough approximation, 100 lbs. of gur of the average composition mentioned above, when treated in this simple manner, may be expected to give about 45 lbs. of sugar of 94° purity[1], and 55 lbs. of molasses of 55° purity, which would be marketed as such.

Much of the colouring matter may be bleached by a single sulphuring, giving a higher grade of sugar. The molasses may be boiled for a second sugar, which is re-dissolved and returned to the liquor, as indicated by the accompanying diagram; in this case we may expect to obtain roughly 56 lbs. sugar of 96° purity[1] and 40 lbs. molasses of 40° purity, from 100 lbs. of gur. In some cases, depending on the composition of the liquors and the plant capacity available, the exhaustion may be made in three stages, the third massecuite being boiled high, left in concrete tanks for a few weeks, pugged and centrifugalled, and finally re-dissolved and returned to process.

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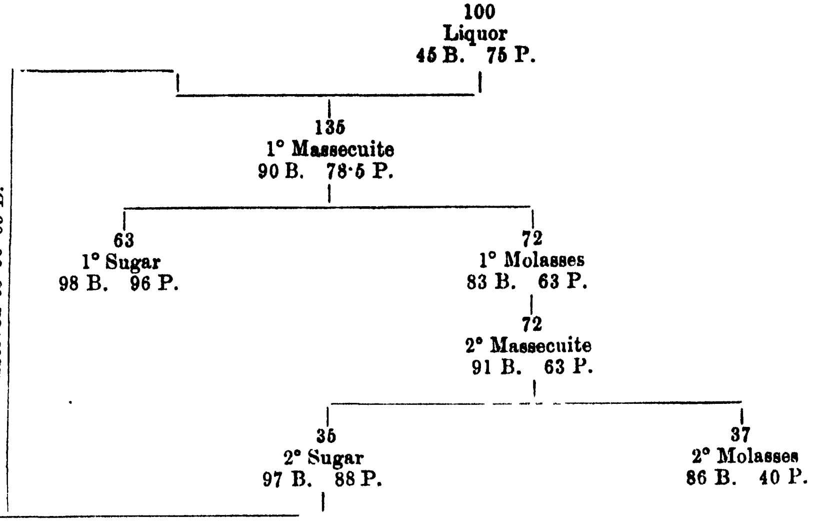
[1] 42–43 per cent. is the usual recovery, of perhaps a slightly higher purity.



B = Brix. P = Purity. Quantities refer to solids.

The 96° sugars may be raised in purity by washing in the centrifugals, or by double curing, with, of course, a corresponding amount of dissolved solids returned to process for further refining. With the higher grade gurs, a satisfactory sugar of 98-99° purity can thus be obtained, which will be nearly white providing proper attention has been given to the sulphuring. With the lower grade gurs, and especially those from date palm juices, if a 99° purity white sugar is required, practically the only method is first to recover as much sugar as possible at something over 90° purity, with a preliminary sulphuring of the liquor; then to re-dissolve, lime and sulphur to whiteness, filter, re-crystallize, etc., as best white sugar.

For the highest grade of refined white sugar, the liquor is, of course, filtered through bonechar, but in India the laws of caste generally preclude the use of this process for sugar intended for consumption by Indians, so that the sulphitation process is usual. India would appear to offer a favourable field for the use of vegetable carbon for decolorizing purposes, if the cost can be brought down to compare with that of sulphitation.

In many parts of India, a white sugar, finely pulverized, is very highly esteemed, and when this is to be made, the size of the grain formed in the vacuum pans is not of vital importance, so long as it is large enough to be retained by the centrifugal gauze. Even with the fine powder, uniformity of size of the particles is of importance; the sugar must be properly dried, and then pulverized in high-grade 4-roller pulverizers, with accurately ground rollers and micrometer adjustments, exactly similar to those used for flour milling.

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[1] The usual recovery is from 52-53 per cent. in Northern India to 57-58 per cent. in Southern India.

The Cause of Mosaic Disease of Sugar Cane.

A Step toward the Solution of this Mystery.

By ARTHUR H. ROSENFELD,
Special Technologist for Cane, Insular Experiment Station, Porto Rico.

The term "germ" is very broad in its significance and is frequently employed as indicating practically any sort of organism causing infection or disease in animals or plants. It is, nevertheless, a far call from the *bacteria*, or minute vegetable organisms which reproduce themselves by fission, which are the cause of such human diseases as cholera, typhoid fever, leprosy or charbon, to the filamentous *moulds*, which are responsible for so many skin diseases in man as well as the domestic animals, or to certain forms of *yeasts* which cause diseases amongst animals. In the Tropics the majority of the most dreaded diseases of human beings, such as malaria and sleeping sickness, are caused by the introduction into the system of a small animal organism composed of a single cell, and recent scientific investigations have tended to indicate that a considerable number of the diseases of cultivated plants may be due to this same class of "germ."

There are a number of diseases, human as well as plant, of which the causative organism is still not definitely determined, notwithstanding the fact that some of our most prominent bacteriologists and mycologists have dedicated entire decades to searching for them. Amongst plants the group of diseases known as "Mosaics," from the form of the discolorations in the leaves of the affected plants, has received much attention and investigation without any definite isolation of the causative organisms being yet accomplished. To this class of disease belongs that affliction of sugar cane which has been the cause of so much havoc in various sugar-producing countries—Sugar Cane Mosaic.

It is evident that this disease is caused by an organism, since it may be transmitted from infected to sound plants, as has been demonstated by **Brandes** in Cuba, **Kunkel** in Hawaii, **Chardon** and **Veve** in Porto Rico and others. In recent years the concensus of opinion amongst the workers with this disease has tended to place the causative organism in that class of minute bodies generally denominated as *ultravisible* or *filtrable virus*. The term *filtrable* indicates that the virus or serum is so fine that it can be forced through the pores of the best cooked porcelain—pores so small that they can hardly be distinguished with the most powerful microscope—and yet retain their virulence, although this class of filtration will eliminate all organisms commonly visible under the microscope.

The well-known "Foot and Mouth Disease" of bovine animals also belongs to this class of diseases which is supposed to be caused by a *filtrable virus*, and it is with the organism causing this particular disease of perhaps the most important amongst domestic animals that discoveries have recently been made in Germany by the bacteriologists Doctor **Paul Frosch** and his colleague Prof. **Dahmen** which may throw considerable light in the path of future investigation of the causal agent of sugar cane mosaic. **Franz Schikora**, associated with the two eminent bacteriologists above-mentioned in this piece of scientific research which may be epoch-making in its consequences, has written for the *Vossiche Zeitung*[1] under the striking title of "Our Most Minute Enemies Unmasked" a fascinating account of this discovery which admirably demonstrates not only the importance of the work of Doctors **Frosch** and **Dahmen**, but also the complete interdependence of the various branches of modern science.

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[1] Berlin, 27th May, 1924.

In speaking of the invasion by the German bacteriologists of what he aptly calls "the hypothetical field of unknown vegetable life" and the annexation of this territory to the field of recognized bacteriology, SCHIKORA says:—

> "Dr. FROSCH reasoned that the invisibility of these disease producers is the result of their extremely small size which inhibits our seeing them even with the most powerful of microscopes. It may be that the layman does not realize that even the microscope has its limitations. If an object be so small that it deflects or interrupts only a few rays of light of distinct lengths, which rays combine to form white light, the image which reaches the retina of the microscope observer is absolutely undefined; or if the object is sufficiently small no image whatsoever is produced. Such objects are really invisible even to the best aided human eye. It was necessary to find some way of making them visible.
>
> "It is the essence of scientific genius to be able to utilize a method developed in some other branch of science for solving a problem along the line of one's own particular speciality, To this inspiration we have to give thanks for many of our discoveries."

Dr. FROSCH followed this procedure in utilizing a very original and ingenious microphotographic apparatus designed by Prof. KOHLER of Jena, who had originated it with the idea of employing the ultra-violet rays, invisible to human sight, for increasing the clearness and definition of certain visible objects. The greatest contribution of Dr. FROSCH, according to SCHIKORA, was "the utilizing of this same apparatus and this same method in obtaining images of objects which were before invisible."

The first disease attacked by Dr. FROSCH was bovine pneumonia, the causative "germ" of which had already been propagated by him and Prof. LOFFLER some time before, but the organism of which they had not yet been able actually to see, since it manifested itself in a sort of white cloud which up to that time they had not been able to resolve into its component parts. After long and patient experimentation Dr. FROSCH succeeded in obtaining with the above-mentioned apparatus photographs of these organisms which proved to be inconceivably minute fungous structures.

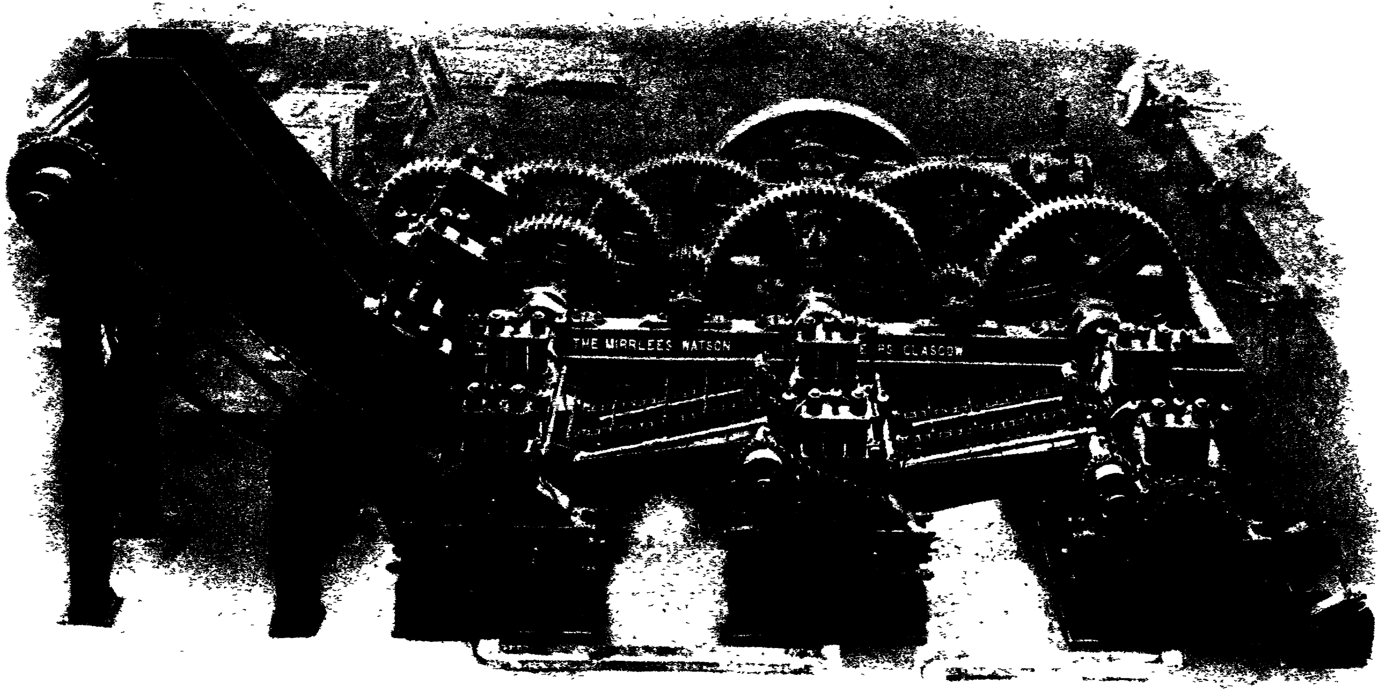
Successful in this attempt, Dr. FROSCH turned his attention to the "foot and mouth disease," the causative organism of which had never yet been cultivated in dry culture—something absolutely indispensable for Dr. Frosch's purposes. "Here," SCHIKORA tells us,

> "Dr. DAHMEN comes upon the scene. This expert bacteriologist devoted himself to discovering not only an appropriate culture medium, but also some method of propagation which would render it feasible to grow the organism outside of the body and without moisture. Only a specialist can appreciate the difficulties here presented. Fortunately Dr. DAHMEN not only settled this problem satisfactorily, but also made discoveries which will aid us materially in combating the pest."

In order not to enter into details of too complex a nature, it is sufficient to say that, as the result of long and patient endeavour, the enthusiastic scientists finally succeeded in obtaining micro-photographs revealing the bodies causing "foot and mouth disease." It is a bacillus of a maximum length of not more than one ten-thousandth of a millimetre—about one quarter millionth of an inch! SCHIKORA concludes:—

> "The course to follow in future investigations has been plainly set. One of the great victories on the field of medical exploration has been won. Besides the term "ultravisible virus" now passes out of fashion."

It appears that, with the author of this interesting and suggestive article, we may have confidence, now that the black continent of unknown bacteriology has twice been crossed, that other of her secrets will be revealed to the man of science, and we hope that amongst these and perhaps at no far distant date we shall learn more of the mysterious secret of the organic cause of sugar cane mosaic disease.



ELEVEN-ROLLER CANE MILL PRESENTED TO THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD.
BY THE MIRRLEES WATSON CO., LTD., GLASGOW.

11-Roller Cane Crushing Plant presented to Imperial College of Tropical Agriculture, Trinidad.

As our readers will be aware, the Imperial College of Tropical Agriculture in Trinidad are having built a complete cane sugar factory in which the students may have the opportunity of learning at first hand the process of sugar manufacture. The illustration produced opposite shows the cane crushing plant especially designed for and presented to the College by The Mirrlees Watson Company, Ltd., of Glasgow.

As will be seen, it consists of three 3-roller mills, all the rollers of which are 16 in. diam. by 21 in. long, preceded by a 2-roller crusher of the same size, capable of dealing effectively with at least two tons of cane per hour. The pressure regulators consist of heavy spiral springs capable of imposing a load on the top-roller of the mills and crusher varying from 30 to 40 tons, depending upon the length to which the springs are initially compressed by means of the caps and nuts. The bottom rollers of the 3-roller mills are adjusted by set screws through the side caps. Special provision is made for adjusting the position of the trash turner by means of lever and retention screws, clearly shown in the illustration. The intermediate conveyors are driven from the top rollers of the second and third mills respectively. These conveyors consist of steel troughs along the bottom of which the cane is pushed by steel paddles fixed to two endless chains. Each conveyor can be stopped independently of the rest of the mill plant by means of friction clutches carried at the end of the driving shafts.

The juice expressed from the cane by the various rollers drops into trays formed in the mill beds, from which it is carried away to a receiving tank by the gutters shown in the foreground. The bagasse is conveyed from the last mill by means of a steel chute, and deposited in the boot of an elevator, which carries it to specially designed furnaces at the boilers where it is used for generating the steam required for driving the mill plant, and operating the boiling house.

All the rollers of the plant are driven by a single 12 in. × 20 in. engine, through spur gearing so arranged as to give roller surface speeds varying from 17 to 20 ft. per min. in the various mills when the engine is being run at 90 revs. per min. The engine is fitted with link motion reversing gear, so that all the rollers of the mills may be reversed.

The death is announced at the age of 80 of Dr. WILLIAM CARTER STUBBS of Louisiana. He is perhaps best known to the sugar world at large as the author of Stubbs' *Sugar Cane*, a work he produced in 1897 but did not seemingly care to revise and re-publish in more recent years. By profession a sugar chemist, he was nevertheless a successful exponent of agriculture, and he started the first sugar experiment station in Louisiana, at Kenner in 1885 ; this was subsequently removed to the well-known Audubon Park site, and STUBBS served as its Director till 1905 when he retired. He also established the experiment station in the Hawaiian Islands for the United States Government.

At the annual sugar congress held at Soerabaia, Java, last April, at which were present some 400 representatives from all over Java, there was an exhibition of technical goods, sugar machinery, electrical appliances, etc. Amongst the firms of manufacturers represented at this display, are stated to have been the following: Messrs. "Heemaf" (Hengelsche Electrische en Mechanische Apparaten-fabriek) ; Ingenieursbureau Vrins; Hoek's Machinenfabriek; Instrumentenfabriek Gerbs ; Messrs. van Leersum ; N.V. Technisch Bureau Vraag en Aanbod ; Motorenfabriek Deutz; the International General Electric Co., Inc. ; and the London-Java Engineering Agencies, Ltd.

Fifty Years Ago.

From the "Sugar Cane," October, 1874.

EDWARD L. CULL, published in this number of our predecessor an article entitled "The Treatment of uncrystallizable Syrups of Beet Sugar with Phosphoric Acid." He had observed in the carbonatation of syrups that on continuing the action of the CO_2 until an acid reaction is indicated some lime still remained in solution. His conclusion was that this effect was due to either of the following two circumstances: (1) there were "kinds of lime unaffected by carbonic acid"; and (2) notions current regarding the effect of lime in beet juice were erroneous. He accepted the former view that "some kind of lime remained soluble in the syrup and resisted the action of the carbonic acid, preventing crystallization." He therefore resorted to some other agent which could be used for the precipitation of lime, and decided upon phosphoric acid, with which he obtained very successful results apparently independently of SCHIEBLER.[1] He thus reached a satisfactory conclusion in spite of a faulty premise.

R. FRAZER SMITH described "an easy and practical method" for the estimation of potash in syrups and sugars, which probably gave results fairly close to the truth, his procedure being as follows: Weight 100 grms. of syrup in a beaker, add 30 c.c. of alcohol and 30 c.c. of water containing in solution about 15 grms. of tartaric acid. Stir vigorously for a few minutes, then allow the mixture to rest for about half-an-hour. Collect the precipitate upon a tared filter, allow it to drain, then wash with 60 c.c. of mixed water and alcohol. Dry in a water-bath and weigh." One-fourth of the bitartrate was taken as potash (K_2O), which result could be checked by carbonizing the precipitate, leaching out with water, and titrating the solution obtained with normal acid. Determinations made by this method showed the assumption of two-fifths of the ash being potash to be only approximately correct.

SCHIEBLER published a note on "The Determination of the Yield from Crude Sugar," according to which a weighed quantity of the sugar under examination was placed in a flask and washed successively with the following liquids: (1) 85 per cent. alcohol containing 50 c.c. of acetic acid per litre, and saturated with pure sugar; (2) 92 per cent. alcohol, saturated with sugar; and 96 per cent. alcohol, also saturated with sugar. Finally, the sugar under examination was washed with a few drops of absolute alcohol, dissolved in water, and its amount determined by means of the saccharimeter, this amount being assumed to be a fair indication of the yield obtainable in refinery practice.

Lastly, there was an article on the sugar industry of Natal, and the following extract gives some idea of the state of the industry at that time: "Here the vacuum pan has only been employed by a few. We cannot reckon up more than ten that are now in operation. The demand until lately was for a coarse dark sugar, but with increased wealth has come an improved taste. The sugar that will sell best at home will be either concrete or a high-class vacuum pan sugar fit for immediate use in British households."

Many examples of the application of the properties of colloids in manufacturing processes are to be found in writers of antiquity. H. A. AUDEN[2] calls attention to a description of the use of bullock's or of buck's blood by Agricola (*circa* 1561) for the clarification of liquids; and other examples are to be found in the classics.

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[1] See *I.S.J.*, 1924, 352.

[2] *Chemistry and Industry*, 1924, 43, No. 40, 987-988.

Cane Sugar Production by White Labour.

Testing the Issue in Australia.

By T. D. CHATAWAY.

Australian sugar producers are increasing their output despite the warnings, which are rather popular in certain circles, that the cost of production, especially wages, is so abnormal that this country cannot compete with others. A Tasmanian delegation has been enquiring into the beet sugar industry of Victoria, and there is reason to expect that in the island State the beet industry will soon be commenced. Victoria is arranging to double the output of its solitary sugar beet factory, raising the capacity from 300 to 600 tons of beets treated every 24 hours. In the tropical areas sugar cane is being increasingly cultivated. The new district on the Tully river is certain to produce an additional 15,000 tons of sugar, while in the Mackay district there is a proposal afoot to amalgamate the North Eton Central—the first central mill established back in 1886—with the Marian Central, thus creating an establishment with a capacity of well over 15,000 tons of sugar per season. The prospects, as forecasted, of the current season seem likely to be fulfilled, even beyond the estimates of four or five months ago. Practically all the mills are in full work, and even at this early stage there are many cases of cane analysis which show a richness in excess of either expectations or estimates. It is curious to note that in some districts, especially below the tropic of Capricorn, there is regret at the absence of what are called "ripening frosts," but unless heavy frosts come during the present winter, or a very early wet season—say in the first half of December—suspends crushing, it is expected that the output of sugar will be something like 370,000 tons, including 20,000 tons of cane sugar from the northern rivers of New South Wales. This means that at the end of June, 1925, there is likely to be a surplus in hand of 70,000 tons, and this, allowing for a carry-over stock, would mean that we must export in one form or another 50,000 tons. Added to this there is every reason to think that the production, with the Tully district and increased areas elsewhere, will, provided the good seasons hold, be still greater in 1926.

THE PROBLEM OF EXPORT.

There are, of course, critics who declare that the difficulty of the industry in regard to finding profitable markets abroad, is the natural outcome of the Commonwealth having encouraged the production of sugar—having, in short, spoon-fed it. By them it is pointed out that the same difficulty has risen in regard to dried fruits. These last have also been overproduced, so we are told, but Senator R. V. WILSON, a member of the Government, who has recently spent many weeks at Wembley, declares that it is not the production which counts but the management of marketing. In the case of sugar there is a very competent Board of Control, and one cannot help believing that it will find a way out of what is freely considered an impasse. That opinions even in the industry differ, may be gathered from the fact that the *Australian Sugar Journal*, in a leading article, says that to sell sugar abroad at present prices would mean a loss of £10 a ton, including freights and charges, while the President of the Australian Sugar Producers' Association, Senator T. W. CRAWFORD, a member of the Bruce administration, expresses the opinion that the prospects of selling profitably are extremely favourable. Clearly the Board of Control does not regard the position with very much misgiving, for while the price of 94 per cent. raw sugar has been fixed at £27 at the mills, it has decided to hold up only £1 a ton in order to compensate it for possible losses on export. This would give £370,000 to meet the loss on 50,000 tons, or something over £7 a ton, which is £3 less than the loss estimated by the *Australian Sugar Journal.* But as I write sugar prices appear to be hardening, and possibly the information of the Board as to the prospects of the future may have made it more optimistic than the Journal. It was not unnatural that the inquiries made by the Central Cane Prices Board into the costs of production should have shown that the growers could not contemplate with equanimity any reduction of prices below £27 a ton for raw sugar, but already the price has been lowered to £26 by the action of the Board of Control, and no complaint so far has been made. Indeed, at the present moment the labourers in the industry are applying for a large increase in the basic wage on the grounds that by the introduction of machinery and improved methods the sugar producers are making increased and, therefore, excessive profits in which they should share.

This application itself stands as a testimonial to the fact that those connected with the industry are not neglecting the necessity of being progressive.

ATTITUDE OF THE INDUSTRIAL COURT.

It may be interesting to make some reference to the general attitude taken up by the Full Court attending to Industrial matters. Mr. JUSTICE DOUGLAS, in giving the unanimous decision of the Court, commented upon the fact that the price of raw sugar had fallen from £30 6s. 8d. in 1921 to practically £26 this year, and emphasized the fact that the Court adhered to the principle of not so much considering the prosperity of the industry as what was a fair basic wage for those engaged in its irregular employment as compared with the basic wage of those in fairly regular employment. The judge pointed out that the alleged excessive prosperity of the farmers was based upon unreliable information. There might be a few growers making large profits, but income tax returns showed that this was not the case with the great majority of the farmers, who were only cultivators on a small scale. The figures relating to a large number of mills showed that the farmers supplying 500 tons of cane and under numbered 3394; those supplying between 500 tons and 1000, 712; and the farmers supplying over 1000 tons, 498. This accounts for 4604 farmers, and there are probably not more than 500 in addition. Seeing that the great majority harvest less than 500 tons, even at an average of 45s. per ton of cane, the gross receipts would be somewhere in the neighbourhood of £1000, out of which the farmer must maintain himself and family, pay for fertilizers and labour, and either rent, or interest on the capital he has invested. It was admitted that in some districts farms were changing hands at fabulous prices, but this was true only to a restricted extent, and was chiefly attributable to the influx of a foreign element into the industry of recent years. The Court had no hesitation in refusing to interfere with existing rates, and significantly referred to cases where last year the men refused to accept the award, as a reason why the application for preference to unionists should be refused. The Court even went so far as to warn the workers that if there was further trouble the modified form of preference now conceded by the employers and granted by the Court might be brought under review.

Generally speaking, therefore, the labour conditions of last year remain, with an indication that the workers must observe them or possibly worse will happen to them. It is encouraging to reflect that this judgment is accepted without complaint, showing plainly, in conjunction with previous appeals, that what has appeared to be unreasonableness of white labour is finding its remedy when duly dissected and exposed by a legal tribunal. Meanwhile it is instructive to note that the white man, supposed to be impossible in the tropics, is flocking into the northern sugar districts far in excess of the demand, and the union officials are urging that steps be taken to restrict the influx of whites into the tropical sugar areas.

Solving the Wages Problem.

It cannot for a moment be supposed that the excess supply of white labour in the sugar districts will result in a reduction of wages costs. That sort of thing cannot happen, unless there is practically a Labour revolution. In individual cases it may result in somewhat decreased cost of production, but upon the grand scale—never. To lower wages must be a long and laborious process, and the sugar people themselves do not feel that they are over-paying their labour. It remains for the critics in the extra-tropical areas to complain that wages in the sugar industry are too high. But there are methods by which the cost of production may be reduced. At Cairns mechanical handling and ship-loading of sugar will commence next month, and quite a definite saving in the cost per ton will be made. The Sugar Control Board, which I have mentioned before, has forced down the cost of carriage by sea of the raw sugars to the refineries. It could get no relief by negotiation and so called for tenders for the carriage of the crop of raws to the refineries. A contract was made saving the mills something like 13s. 6d. a ton on last year's average cost of carrying the raw sugar to the various refineries, which are scattered through the different States. *The time is approaching when the refineries will follow the example of the raw sugar mills and concentrate, thus reducing actual refining costs, and avoiding the excessive harbour and port dues.* But this, of course, applies to sugar produced for local consumption, and does not touch sugar for export.

Regarding this last there seems little question that the common estimate of £10 a ton for freight and charges upon exported sugar is far too high. I have noticed that it is stated that freight and charges from Sydney to, say, Cairns (about 2000 miles) for carrying nitrate of soda are 50 per cent. higher than those from Iquiqui (Chile) to Sydney. Obviously from this uncontradicted fact it must be possible for Australian 94 per cent. sugar to be carried from such ports as Mackay and Cairns direct to London or U.K. ports, at a far lower cost than that involved by shipping along the coast. It will take time but the solution of the problem of selling white-labour sugar abroad is by no means impossible, unless we assume that it must happen that cheap coloured labour and highly scientific and labour-saving operations are capable of being brought together. Mr. R. A. Quintus, in his excellent book on Cane Cultivation in Java, makes it clear that this cannot be done. The experiences with labour in Cuba and the Philippines are sufficient evidence that the days of a subservient coloured race of hewers and drawers belong to the past. But the subservient race, being on the spot, must be catered for.

Cheapening Field Losses.

The Australian sugar producers thus seem faced with two problems. They have solved that of cheap manufacture and, largely, that of cheap transport. There remains that of cheap growing and harvesting of the cane, to which must be added the abolition of losses in production. The harvesting question still remains unsolved, largely for reasons set out by me as far back as in May, 1920. Our farms are on a small area basis, and the farmer is not able or disposed to risk the trying of a cane-cutting machine, the failure of which might not so much lose him money as make him the subject of boycott by highly organized manual labour.

It is estimated that it would cost £5000 to land a Luce machine in Queensland' and perhaps twice as much to finally test it. *Pari passu*, the same figure applies to locally-produced machines. Yet a harvester must come, and with it the cost of cane, delivered at the mills, will be brought down to the Java level, while the white men employed will earn higher wages than any paid in other parts of the world. The point is not being lost sight of, and the Australian Sugar Producers' Association has it always before its collective mind.

The next great economy is that of actual cultivation. Already tractor implements are becoming commonplace, but the question of a cheap motor-fuel is ever with us. It may be necessary to adapt internal combustion engines to the employment of motor alcohol, but the Commonwealth Bureau of Science and Industry has given us the assurance that in this matter there will be no difficulty. Sir GEORGE KNIBBS, the Director of the Bureau, and previously the world-famed Commonwealth Statistician, has told us that every ton of molasses is worth 20s. as material for making commercial industrial alcohol, and this is verified by the fact that the Colonial Sugar Refining Company is importing molasses for 20s. a ton from Fiji, and converting it into industrial alcohol which it sells at 2s. 6d. a gallon. Thus the farmer is on the high road to securing ample supplies of motor spirit on the spot in each sugar district for use in connexion with his field implements. The elimination of the horse is one of the chief economies possible in the field, apart from the harvesting question. As each ton of sugar leaves behind it 5 cwt. of molasses it is clear from the above that there will be added to the value of sugar at least one-fourth of 20s., or 5s., to say nothing of the economy the farmer will effect by the use of tractor implements in the field. While on the subject of power alcohol it may be mentioned that the Commonwealth Government is now using its acetate of lime factory, at Brisbane, for the purpose of distilling molasses and making motor spirit for its own use in the Defence and Postal Departments. The factory has only the capacity to use 4000 tons of molasses per annum, from which it will make 250,000 gallons of motor spirit, and has already produced several thousand gallons. The official figures will supply data for comparison, while the actual work will be a useful object lesson to the sugar people.

SAVING MONEY BY CHECKING LOSSES.

The prevention of losses has not been overlooked. The almost monthly bulletins published by the scientific department of the State Government of Queensland, which not unnaturally looks upon cane sugar production as almost the chief productive, and certainly the chief national, industry of North-east Australia, show how closely every step in entomological and pathological progress is being followed.

The grey-back cockchafer, or *Lepidiota albohirta*, known in Europe and elsewhere, and responsible in Queensland for the destruction of thousands of acres of cane and grass, has about met its Waterloo. The breeding of parasites, the injection into the ground of chemicals, and the more ordinary methods of dealing with the pest, have brought it practically under control, while the scientists do not sleep, day or night, in following up all the reported diseases or new injurious insect developments. Thus the farmers' losses are being reduced to a minimum, and when the losses are eliminated it obviously follows that the cost of production becomes less. In brief, machinery and science will solve the white labour problem.

AN ADDITIONAL ITEM.

The proposition to establish a Celotex factory in Queensland is apparently well on its way to fulfilment. The latest news on the subject is that the ex-Prime Minister of Australia, Mr. W. M. HUGHES, P.C., and the Hon. A. J. JONES, a member of the Queensland cabinet, have been examining the factory on the spot in Louisiana, U.S.A., and are quite satisfied that a similar factory can be successfully established in Queensland. Exactly what value that will place upon bagasse is not yet disclosed, but one cannot help feeling that it will be greater than that of the crushed cane as a fuel. Some years ago in Hawaii the largest sugar mills could not consume all the bagasse for which they were responsible. To-day in Queensland the mills are fast assuming the size of the Hawaiian mills of those days, and consequently we may presume that they also will have much bagasse to spare, even after satisfying their fuel requirements. The value of the timber, of various varieties, imported last year into Australia, aggregated something in the neighbourhood of £5,000,000 in value. All of this, of course, could not be supplied by Celotex, but there is no question that the local synthetic timber would secure a considerable amount of that trade. This is, of course, still in the lap of the gods but the progressive sugar producers believe they see a further and profitable use of one of their chief by-products in this new manufacture.

Present Needs in Cane Disease Control.

By H. ATHERTON LEE, Pathologist,[1]

Hawaiian Sugar Planters' Association Experiment Station.

An ounce of prevention is worth a thousand pounds of cure. This is the old Scotch epigram modified to fit the situation in regard to the curing of cane diseases, and it is not at all difficult to find instances to illustrate the truth of this old saying.

Take the case of mosaic disease: nearly all cane men know of the outbreak of this trouble in Porto Rico. There is considerable circumstantial evidence to indicate that mosaic disease has been well established in Oriental countries for years and that it is a trouble comparatively new to sugar countries of the Western Hemisphere. Mosaic disease was known in Java as early as 1890 and has existed in the Philippines for years; it was first noticed in Porto Rico in 1916. The disease is known to have spread to Egypt on cane cuttings imported from Java. Cuttings of cane from Java are also known to have been imported into the Argentine and it is known that cuttings with mosaic disease were introduced into Porto Rico and Cuba from the Argentine.

If we go back over this trail therefore, it can be seen where mosaic disease could have been stopped inexpensively and easily. If the cane introduced into the Argentine had been carefully selected in Java, there would have been no mosaic disease in the Argentine. If the cane had been carefully selected in the Argentine before its introduction into Porto Rico, the trouble would have been prevented very economically in Porto Rico. Exclusion of mosaic disease would have saved Porto Rico from enormous expense, and expense which is being repeated year after year and probably will be repeated annually for some time to come. Exclusion of mosaic disease would have saved sugar yields for the Argentine and for Cuba and Louisiana, also, at practically no cost.

But there are other good illustrations of the way in which an ounce of prevention of cane diseases is worth many pounds of cure. Fiji disease, which is a comparatively new trouble in the Philippine Islands, is another good instance of how precautions to secure exclusion would have saved some of the growers considerable worry and added to their cane yields year after year. Fiji disease has been known in the Fiji Islands, Australia and New Guinea since the year 1910. In 1916 it was found in the Philippines and there is circumstantial evidence to indicate that it was introduced there on cane cuttings imported from Australia about the year 1912.

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[1] Formerly Director of Sugar Cane Investigations for the Philippine Sugar Association, and delegate for the Philippines to the Pan-Pacific Food Conservation Conference.

There are many other examples: Downy mildew of sugar cane is a disease carelessly imported into Formosa and later from Formosa into the Philippine Islands. A new trouble, known as red stripe, caused by bacteria, is an introduced disease in Hawaii; gum disease, also caused by bacteria, is an introduced trouble in Porto Rico; wilt, caused by a fungus, is an introduced disease in the Philippines.

There are two extreme views in regard to cane diseases. One class of cane men regards all cane diseases as devastating, calamitous troubles and the word "disease" to them brings up visions of blighted crops and bankruptcy. Another class looks upon all cane diseases as negligible troubles, similar in nature to leaf spots. There is a middle ground which regards cane diseases as having varying degrees of seriousness. Leaf spots, as a rule, are usually negligible except under extreme conditions favouring their development. On the other hand, there are more serious troubles, such as mosaic disease, Fiji disease, cane smut, downy mildew, and gum disease, which very materially lessen yields. Although entire destruction of a crop is a very rare thing, in some cases one or several of these diseases have been known to cause total failure in one or several fields. Whenever one of these troubles is at all common there is usually such a material reduction in yields as to form the difference between profit and loss, particularly in years of poor prices.

Probably the worst cane disease in the countries of the western hemisphere is mosaic disease. This is only one serious trouble, while in Oriental countries there are a number of diseases, any one of them often as serious as mosaic and sometimes more serious.

Fiji disease, for instance, is an infectious trouble, known to be transmitted by cane cuttings but the cause of which is unknown; it is now found in Fiji, Australia, New Guinea and the Philippines, and has not yet been introduced into cane countries of the Western Hemisphere, nor has it reached Java, India, Mauritius, Natal or Egypt as yet. This disease can be prevented with no cost at the present time in Hawaii, Cuba, Porto Rico, Louisiana, the Argentine, Mauritius, India, Egypt, and Java by entire exclusion. In other words, now is the time to exercise the ounce of prevention for Fiji disease. No canes should be imported into these countries from Australia, the Philippines, or Fiji except after personal inspection by a competent authority on cane, cane diseases and cane insects. Even after such selection the new cane varieties, when imported, should be kept in isolation for the plant crop and one ratoon crop. Distribution of cuttings of the new imported variety should not be made until the first ratoon crop has been harvested. We know of no cane varieties, as yet, with any high degree of resistance to this trouble. H 109, the Cheribon canes, Yellow Caledonia, Uba and all commonly grown varieties are susceptible.

Downy mildew is another trouble, caused by a fungus, and known to be transmitted by cane cuttings; it is only found in Formosa, the Philippines and Australia and has not reached the Western Hemisphere and is still unknown in Java, India, Mauritius, Natal and Egypt. In the Philippines, Uba cane is especially susceptible to downy mildew.

Present Needs in Cane Disease Control.

Cane smut, caused by a fungus, is known to be transmitted by cane cuttings; it is reported from India, Natal, Java, Italy, Mauritius, the Philippines and Australia, and two points in the Western Hemisphere, Trinidad and British Guiana. In the Philippines, Uba cane is also especially susceptible to cane smut.

Sereh is a trouble, the cause of which is unknown, but it is well established that it is transmitted by cuttings. It is authentically known only in Java as yet, although there are reports that it is also in Formosa. It is not known as yet in any of the other cane countries. It is probably only good fortune that it has not been introduced into the Argentine since cuttings were imported there direct from Java.

Gum disease, caused by a bacterial organism, was first known authentically from Brazil and later, in the year 1893, from Australia. It is also known in New Guinea, Mauritius, Réunion, and Porto Rico. What is considered a similar trouble is known in Java, Borneo and the Philippines. It is transmitted by cane cuttings. Gum disease is not known as yet in Hawaii, Formosa, India, Egypt, Natal, Louisiana nor Cuba. A new trouble is being reported from Australia, known as leaf scald, caused by a bacterial organism. It is not known in other countries, nor is red stripe disease, a new bacterial disease in Hawaii.

These are the more serious troubles, the most of which have not yet become established in the cane countries of the Western Hemisphere. The absence of these diseases is a considerable advantage to western countries in competition with oriental lands where labour is so much cheaper. This advantage may be maintained by the exclusion of these cane diseases. What is needed in cane countries of the Western Hemisphere is a considerable campaign of publicity concerning these well established and destructive cane diseases in the Orient. Every cane man should know of the existence of these diseases in other countries, and having such knowledge, should insist that no cane importations be made except by competent cane men working in close contact with men versed in cane diseases and cane insects. It is a sad fact to contemplate, but in the illustrations of the importance of cane diseases which have just been related, in four instances Government experiment stations and rather well-known cane men are implicated as having brought about the introduction and distribution of these diseases; inadvertently and innocently, it is true, but nevertheless the harm has been done.

To summarize: an ounce of prevention against cane diseases is worth many pounds of cure. Now is the time for cane sugar producers in the countries of the Western Hemisphere to exercise the ounce of prevention against Fiji disease, downy mildew, sereh, cane smut, wilt, gum disease, leaf scald and possibly other unknown troubles and numerous insect pests.

If new cane importations are to be made, and progress in cane production necessitates such importations, selection of the cane cuttings to be imported should be made by a competent authority. The imported cuttings should be grown in isolation under Government supervision for at least one plant crop and one ratoon crop. During this period of quarantine, inspection should be made several times each month by cane men working in close co-operation with cane entomologists and cane pathologists.

The Handelsvereeniging Amsterdam has lately been considering the question of opening up an area in the Krawang district of Java for sugar cane cultivation and building a factory there; and it went so far as to apply to the Government for grants of land. But on investigating the district more closely, it was found that the ground was unsuitable for the purpose intended, so the application has been withdrawn and the project abandoned. Since the Government is said to have expended much time and money in laying out extensive irrigation works near Krawang, this decision of the Handelsvereeniging not to proceed will cause some disappointment.

The Removal of Gummy, Oily, and Waxy Matters from Raw Cane Sugar.[1]

By C. M. KEYWORTH, M.Sc., A.I.C., and R. B. FORSTER, D.Sc., Ph.D., F.I.C.

SLIMING OF FILTER-PRESS CAKES.

In the filtration of liquors and syrups derived from raw cane sugar considerable difficulty is generally experienced with the gummy, oily, and waxy matters introduced in the raw sugar. Especially is this noticeable when decolorizing carbons are used, which are usually indifferent filtering aids. The gums form an impenetrable layer on the face of the filter-cloth, with the result that the filtration efficiency rapidly decreases, the pressure becomes excessive, and the outflow from the press almost negligible.

There is a growing tendency to try to replace bone-charcoal with activated vegetable charcoal or other activated charcoal, which, although 10-20 times as active as bone-charcoal, yet removes gummy matters very incompletely unless used in excessive amounts, and soon, therefore, causes the rate of filtration to become poor. Filter aids such as kieselguhr ("Filter-cel") greatly accelerate the filtering of liquors, but remove little or none of the colour.

ADVANTAGEOUS EFFECT OF PRESS STEAMING.

It was known to one of us that when steam is blown through a spent filter-press which has for some time been used for filtering raw sugar liquors containing decolorizing carbons, the press can then be restarted to advantage without stripping. Investigations were made as to the cause of this, and it was then found that the gummy, oily, and waxy matters were to a large extent volatile in steam. Hence when a filter-press is steamed, the oily film on the cloth[2] is at least partially removed, and the power of filtration restored. But the process cannot be repeated indefinitely, as it becomes less effective each time; and, moreover, the steam has a scorching action on the filter-cloths.

EXPLANATION OF THIS EFFECT.

A sample of raw sugar was dissolved in an equal weight of water in the laboratory, and the solution heated to boiling point *in vacuo* while steam, generated in another flask, was passed through the solution. It was found that the bulk of the gummy matters passed over in the distillate. The residual liquor was then reduced to the same density as the original solution, and their rates of filtration were compared. It was found that the rate of filtration of the steam-treated liquor was approximately twice that of the original liquor. Further experiments with raw Peru and Java sugar confirmed this. The gums were not removed quantitatively, but the amount could not be determined, as no completely satisfactory method for this purpose appears yet to have been devised.

The time required to remove the maximum amount of gums naturally depends on the quality of the sugar. Generally speaking, steam was passed through the solution for about half-an-hour, the liquor being maintained at a temperature of 50°-60°C., and a vacuum of about 650 mm. used. The density of the liquors was kept at about 60° Brix. To compare the filtration efficiencies, decolorizing carbons such as "Norit" and "Klarit" were used, and also "Filter-cel." In the laboratory trials the increase in efficiency varied from 70 to 100 per cent. with most sugars. The decolorizing power of an active carbon is greater with a steam-treated liquor, presumably because the pores of the carbon do not become clogged with gummy particles.

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[1] *Journal of the Society of Chemical Industry*, 1924, 43, No. 27, 203-206T, here slightly abridged.

[2] "Oily matters" are probably not naturally present in raw cane sugar. Indeed, they do not appear to have been identified in the sugar cane apart from waxes, and in the well-known analyses by BROWNE and BLOUIN in Louisiana Bulletin No. 91 the "fat and wax" is reported together, probably being almost entirely wax. But refiners are at times much troubled with the presence in their re-melted liquors of oily or greasy substances, which greatly hinders filtration. This originates from the most reprehensible practice in raw sugar production (fortunately not generally adopted) of adding oil, fat, or soap to the contents of the pan when the boiling of the strike is troublesome owing to undue frothing.—ED., *I.S.J.*

By permission of Messrs. Macfie & Sons, Ltd., of Liverpool, experiments were carried out on a large scale in their refinery, and the authors are indebted to them for permission to publish the results. The experiments were made on a sample of raw Peru sugar and washed raw Peru sugar which, though of fair quality, was yet difficult to filter with decolorizing carbons. The decolorizing carbon used was "Klarit," and the filter-press a 40-in. washing type plate-and-frame press.

Four experimental filtrations were carried out: (1) on untreated raw Peru sugar liquor; (2) on treated raw Peru sugar liquor; (3) on untreated washed Peru sugar liquor, and (4) on treated washed Peru sugar liquor.

FILTRATION OF UNTREATED RAW PERU LIQUOR.

Five tons of raw Peru sugar were dissolved to a density of 52·5° Brix at 66° C. and 2 cwt. of "Klarit" were added. This liquor was then pumped through the filter-press, and the results recorded in Table I were obtained. The rate of flow through the press was calculated from the time taken to fill the outflow trough. After 1 hr. 25 min., since the liquor was trickling very slowly, the flow negligible and the pressure excessive, the press was stopped. The total amount of liquor run through the press was 600 gallons.

Table I.

Time in min. after starting press	Pressure. lb sq. in.	Rate of flow through press. gall. per min.	Remarks.
4	15 20	—	Frothing badly
6	17-25	—	All taps clear
8	20-27	25·7	—
17	25-35	20·0	—
37	27-42	12·0	—
85	50-60	6·0	—

Treatment of raw Peru sugar by steam in vacuum.—The plant used for subjecting the liquor to treatment with live steam was a Claassen-type vacuum pan. This pan was heated by means of a calandria operated by low-pressure steam, and had a small perforated coil round the inside through which live steam at 50-60 lb. pressure could be introduced. This arrangement was not ideal, but a pan with a larger coil and low-pressure steam was not available.

Ten tons of the same Peru sugar as used in the previous experiment were dissolved in water and drawn by vacuum into the Claassen pan. At the beginning of the operation the barometer stood at 738 mm., and the pressure in the pan at 625 mm. The charging of the pan took 29 min., the pressure then being 610 mm. and the temperature and the density of the liquor being 59° C. and 59° Brix, respectively. Steam was then passed in for 90 min., during which time the pressure became 635 mm., the temperature 54° C., and the density 62·5° Brix. The liquor was then diluted to 54° Brix, and pumped to the filtration department.

FILTRATION OF TREATED RAW PERU LIQUOR.

"Klarit" (2 per cent. of the weight of sugar) was added and the same pumps and press were used as in the previous trial. The pressure rose fairly rapidly, but the flow continued to be very good, and was much greater than in the previous experiment with untreated Peru sugar. After the press had been running for some time, however, it was noticed that the density of the liquor had decreased, owing to the contents of another vessel siphoning through a leaky valve. This vessel was used for washing spent "Klarit" and also contained washings from dirty filter-cloths, so that the water therefrom contained a considerable proportion of non-sugars and was difficult to filter. Unfortunately, it was impossible to repeat this experiment.

The results obtained are recorded in Table II. The amount filtered through the press was 1033 gallons of liquor, plus the unknown amounts of liquor and sweet-water accidentally introduced, as above mentioned.

Table II.

Time from starting of press, min.	Pressure, lb./sq. in.	Temp. of effluent.	Brix.	Level of Liquor from top of tank, in.	Rate of flow, gall. per min.	Remarks.
5	—	77°	54°	15	—	Press full
10	15	—	—	—	—	—
15	25	—	—	—	28·6	—
30	40-50	—	—	—	30·0	—
40	45-55	—	48°	26	24·7	—
70	55-65	—	—	39	20·5	—
90	55-75	—	38°	42	—	Shows water leakage
95	55-75	—	—	46	19·3	
105	55-75	—	—	46	17·1	
120	55-75	—	—	44	—	

FILTRATION OF UNTREATED WASHED PERU LIQUOR.

The same filter-press was used, and similar sugar as in the previous experiments, but this sugar was washed in centrifugals before solution. "Klarit" (2 per cent. on weight of sugar) was added to the liquor. The results obtained are given in Table III:—

Table III.

Time from starting of press, min.	Pressure, lb. sq. in.	Temp. of effluent.	Brix.	Rate of flow, gall. per min.	Remarks.
5	—	75°	41°	—	Press full
8	10	80°	47°	32·7	—
18	18-20	—	46°	22·5	—
23	20-22	—	46°	22·5	—
31	27-30	—	46°	22·5	—
40	30-40	86°	45·5°	20·0	—
50	35-40	86°	44·5°	17·7	—
60	40-55	—	44·5°	15·3	—
67	40-50	—	44·5°	11·2	—
87	45-55	—	45°	9·0	—

The amount of liquor put through the press was 1050 gallons less 175 gallons remaining in the press, that is to say, 875 gallons.

Treatment of washed Peru sugar by steam in vacuum.—10 tons of the same washed Peru sugar as used in the previous experiment were then dissolved in water and drawn into the Claassen pan. Steam was passed through the liquor for a little more than an hour, but owing to the slow rate at which the liquor entered the pan, some of the liquor did not get more than 35 minutes' treatment. The final temperature was 50·5°C., and the pressure 635 mm. Water was then added to bring the density down to 54° Brix.

FILTRATION OF TREATED WASHED PERU LIQUOR.

"Klarit" (1·66 per cent. on weight of sugar) was added and the liquor pumped through the filter-press. The pump took a long time to fill the press, but afterwards worked satisfactorily. The outflow was much greater than in the case of the untreated washed Peru sugar, and the amount put through the press was 1800 gallons.

Table IVa.

Time from starting of press, min.	Pressure. lb. sq. in.	Temp. of effluent.	Brix.	Level of liquor from top of tank, in.	Rate of flow, gall. per min.	Remarks.
20	10	77°	44°	—	—	Press full
27	15	—	48°	—	34·0	—
38	22	—	46·5°	—	30·0	—
43	25	—	46·5°	—	27·7	—
49	27	—	46·5°	—	27·3	—
62	32	80°	46°	40	22·2	—
70	30-40	—	46°	—	20·2	Tank almost empty
88	30-40	—	47·5°	54	18·0	

The press was then steamed off, the percentage of "Klarit" brought up to 2 per cent., and a further quantity of liquor run through the press. The results are given in Table IVb.

Table IVb.

Time from starting of press, min.	Pressure. lb. sq. in.	Temp. of effluent.	Brix.	Level of liquor from top of tank, in.	Rate of flow, gall. per min.	Remarks.
3	15	71°	48°	—	—	Press full
7	25	—	48°	—	27·7	—
11	25-35	—	47·5°	—	22·8	—
17	30-40	—	47·5°	—	19·8	—
62	35-40	—	47°	32	9·8	—

The amount of liquor run through the press was 1075 gallons, less 175 gallons remaining in the press. Hence the total amount run through the press was 1800, plus 900 gallons = 2700 gallons, compared with 875 gallons with the untreated liquor.

Laboratory control tests were carried out. In the first experiment with raw Peru sugar, it was found that inversion occurred to a slight extent during the steam distillation. Thus after one hour's distillation the apparent purity as indicated by the quotient had dropped from 96·76 to 96·71, and when the liquor left the vacuum pan the quotient was 96·45°. The acidity per 10 c.c. of the liquor was 2·2 c.c. *N*/100 sodium hydroxide, using litmus as indicator.

In the second experiment with washed Peru sugar, the acidity was reduced by the addition of lime to neutrality against litmus, but it was acid to phenolphthalein. Similar inversion, however, occurred, the quotient dropping from 98·59 to 98·26 during the time the liquor was in the pan. It is possible that low-pressure steam would have reduced this inversion to a negligible quantity.

Throughout the steam treatment in the Claassen pan, no loss of sugar through entrainment was noticeable.

CONCLUSIONS.

The optimum time required for distillation naturally varies with the sugar to be treated, but from 30 to 60 minutes is usually sufficient if the live steam-coil is of suitable proportions. Longer time than this was taken in the large-scale experiments on account of the unsuitability of the steam coil, and also to ensure that the optimum time had been exceeded, for it would not have been possible to repeat the experiments then. The increase in filtration efficiency is usually about 100 per cent. A more exact statement is impossible, because it is difficult to obtain satisfactory methods of comparing rates of filtration in the laboratory. The viscosity of a sugar solution rapidly decreases as the temperature rises, and it is almost impossible to filter two solutions and keep them at the same temperature. The best method is to use two suction filters heated in a steam oven and connected to the same filter-pump. Ordinary conical funnels in a steam-oven will, however, give a fair idea of filtration values, though of course, the amount filtered is small.

The advantages of the method on a commercial scale are numerous and very obvious. Either raw sugar liquors or the partly exhausted syrups—even affination syrups—can be advantageously so treated before filtration. As mentioned above, the decolorizing power of a given carbon is increased, because the carbon is not obliged to absorb so large a quantity of gums; but the authors have not yet carried out any quantitative experiments. After treatment by their process the amount of the decolorizing carbon required to filter efficiently any sugar-liquor is smaller, if the carbon is added for the purpose of filtration, and not for the sake of decolorization only.

The process is covered by British Patent Application 30,977 of 1923.

The 1923-24 Formosa Sugar Crop.

(Department of Overseas Trade Report.)

The British Consul at Tamsui (Mr. G. H. Phipps) reports that the final figures of the sugar production of Formosa for the year 1923-24 are as follows:—

Names of Companies.	Piculs.
Taiwan Sugar Company	1,670,035
Shinko Sugar Company	95,235
Meiji Sugar Company	1,047,647
Dai Nipon Sugar Company	821,994
Toyo Sugar Company	947,442
Yensuiko Sugar Company	954,634
Rinhongen Sugar Company	267,762
Niitaka Sugar Company	631,919
Teikoku Sugar Company	777,270
Tainan Sugar Company	67,398
Taito Sugar Company	22,491
Schinchiku Sugar Company	36,933
Sharoku Sugar Company	45,471
	7,386,231
Browns	149,416
Total	7,535,647

(equivalent to 444,980 tons).

The results are considerably in advance even of the original preliminary estimate of 6,329,147 piculs which was itself higher than the two subsequent official estimates. As compared with the 1922-23 figures, there is a substantial increase of 1,628,368 piculs (96,155 tons).

The 1923-24 Formosa Sugar Crop.

The following is the first official forecast of production for the 1924-25 season:—

	PICULS.
Centrifugals	7,436,670
Browns	242,448
Total	7,679,118

(equivalent to 453,452 tons).

If these figures are realized, they will not only surpass last year's total, but even that of the 1916-17 season, and will constitute a record for the island.

The area under cane is placed at 134,004 "Ko" (321,171 acres), as compared with 116,902 "Ko" (280,179 acres) for the past season. A deduction should, however, be made from the 1924-25 figures in respect of an area of approximately 6,500 "Ko" (15,579 acres) devoted to cane for seedlings.

Publications Received.

The Heat Balance in the Cane Sugar Factory. A. L. Webre, M.E. (The United States Cast-iron Pipe & Foundry Co., 71, Broadway, New York City, U.S.A.) 1924. Price:

This little book covers very much the same ground as Abrahams' "Die Dampwirtschaft in der Zuckerfabrik." It, however, specializes as regards the treatment in modern cane sugar factories as they now exist in Cuba. Its contents consist mainly of calculations of the heat consumption in various cycles, isolated and separated triples, quadruples and quintuples, pre-evaporators in combination with quadruple, etc. It is to be noted that the author's preference is for an isolated quintuple. He very clearly explains the working difficulties which are likely to arise, especially with lazy or ignorant operators, when the more complex cycles are installed. Thermo-compression is briefly discussed; and the author has hopes when working conditions are more thoroughly understood, that this, perhaps the most rational of all systems, will find a greater extension than it has at present. Attention is very rightly directed to economic loss resulting from unnecessarily allowing juices to cool, and to the fact that a furnace designed for bagasse combustion should be fed with that material and no other. A copy of this book may well be in the possession of all interested in the economic utilization of steam. The only positive error that has been observed is "Beaumé."

N. D.

Methods of Chemical Control for Cane Sugar Factories [in Hawaii]. (Association of Hawaiian Sugar Technologists, Honolulu, T.H.) 1924. Price: $6·00 (bound); or $3·75 (paper covers).

This revision (from the 1916 edition of the methods compiled by the Hawaiian Chemists' Association[1]) has been undertaken by a Committee consisting of W. R. McAllep (Chairman), Herbert Walker, Horace Johnson, W. F. Duker, S. S. Peck, and F. T. Dillingham. Although in the main the treatment of the material is similar to that followed in the previous edition, new matter has been introduced, and some re-arrangement has been made, the compilation now forming an even more valuable statement of chemical control for the use of the cane factory chemist. Thus the section on "Definitions" has been extended; under "Apparatus" there now appears a separate section on the use and care of Polarimeters and Saccharimeters; additions have been made to the section on "Preparation of Reagents"; that on "Weights and Measurements" has also been amplified; and "Sampling" has been given a separate chapter with some new illustrations of suitable apparatus. "Sampling"; "Methods of Analysis";

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[1] See *I.S.J.*, 1916, 468, 513 and 553.

"Calculations for Mill Control," form the main chapters of the book, and have all been revised, a more complete and better arranged statement being given than previously. In passing, it is noted (1) that for the determination of sucrose, Walker's double polarization method is adopted, the modification of Herzfeld's inversion procedure given before being abandoned; (2) that for the determination of glucose the Munson and Walker method is prescribed, as is also the less accurate but more rapid volumetric process using ferrocyanide as external indicator of the presence of unreduced copper salt; and (3) that for the determination of ash the carbonate method is adopted, it being stated that the sulphate method "should be used only when suitable apparatus for carbonate determination is not at hand." Then, "Calculations for Mill Control" have been amplified; and their presentation is now clearer and the arrangement better, some examples being also given. There is a 3-page chapter on Distillery Control. In regard to the Tables, three dealing with: Values of the *sjm* formula; tonnage ratio factors; and concentration factors in the double polarization method are new; whilst that giving the dry substance from the refractive index is now omitted.

Drying by Means of Air and Steam. E. Hausbrand; translated by A. C. Wright, M.A., B.Sc. Third Revised English Edition. Pp. viii + 77 (Scott, Greenwood & Son, London.) 1924. Price: 6s. net.

This small book by Hausbrand now in its third edition, has been found of very great use by engineers requiring to calculate the dimensions of apparatus for drying wet material by means of air. It is indeed a well-recognized guide for such, and hardly requires any introduction to sugar factory and refinery technologists. Compared with its predecessor, this new edition has undergone no important revision, so far as the text is concerned; but an appendix entitled "Metric Conversion Diagrams" containing a series of very convenient charts[1] appears. These enable one directly to interconvert grammes and grains, kilos and pounds, metres and feet, sq. metres and sq. feet; litres and cub feet, litres and gallons, calories and B.T.U.; and mm. of mercury and lbs. per sq. in., which additions will be found of value by many, seeing that in this translation the metric system of weights and measures has been retained throughout.

The Mauritius Almanac and Commercial Handbook for 1924-25. Compiled by A. Walter, F.R.A.S. (The General Printing & Stationery Co., Ltd., Port Louis, Mauritius.) 1924. Price: Rs. 10.

Mr. Walter has again compiled his well-known Mauritius Almanac, and in this edition all the statistical sections, tariffs, etc., has been completely revised and brought up to December 31st, 1923. Dr. Tempany, Director of Agriculture, has again contributed the section on Agriculture, which has always formed an important feature of the Handbook.

Report of the Empire Motor Fuels Committee [and other Papers]. (The Institution of Automobile Engineers, London.) 1924. Price (to non-members): 10s. 6d.

This volume includes several papers of interest to those concerned in the development of alcohol motor fuels, viz.:—The Character of various Fuels for Internal Combustion Engines; The Influence of various Fuels on the Performance of Internal Combustion Engines; Report of the Empire Motor Fuels Committee; The work of Midgley and Boyd on Detonation; Solubility Relations and other Properties of Mixed Fuels; and Further Notes on Fuel Research. Results of tests on 90, 95, and 99 vol. per cent. alcohol, and of alcohol-ether mixtures, are included in the Report of the B. E. Motor Fuels Committee.

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[1] Copyrighted.

Brevities.

Experiments carried out by M. Auffay[1] on the value of different preparations for the preservation of cane with its original colour are said to have shown a mixture of 1 volume of acetone and 9 of water to give the best results. Salicylic acid and mercury bichloride both in 95 per cent. alcohol proved less satisfactory.

In an article on the corrosion problem in the sugar industry,[2] it is mentioned that coal tar or graphite paints have been found serviceable in beet factories for protecting equipment while out of use during the inter-campaign. At the sulphur station it has been found that the use only of cast-iron has been accompanied by a notable diminution of corrosion, compared with plant in the construction of which copper was used. Instead of metal vent pipes, those of concrete or tile should be employed; while for the air ducts for the pulp dryers the use of "Armco" ingot iron has been found to dispense with the necessity of painting. For storing phosphoric acid in the refinery, it is preferred to line the tanks with antimony lead, instead of making them of wood, cast-iron or earthenware cocks being provided.

In a paper read before the second annual meeting of the Institution of Chemical Engineers in London recently[3] Mr. E A. ALLIOTT dealt with self-balancing centrifugals, and his conclusions may be summarized as follows: Precession in self-balancing centrifugals may be minimized by short spindles, when the basket inertia is preponderant about the spindle rather than the buffer, and by adequate buffer control and friction. Whirling is minimized by long spindles, weak buffer control, friction in reason, and adequate acceleration; whilst acceleration is limited by power consumption. Friction is limited by power consumption, wear and tear, and freedom from vibration. Basket shapes are limited by loading requirements and necessity for ease in loading evenly. Critical speed is the most important of the calculable factors relating to a flexibly supported machine. Good centrifugal design is dependent on an adequate balance being struck between the various factors mentioned.

In a remarkably interesting address on Chemotherapy, Dr. H. H. DALE, F.R.S.,[4] discussed dyes which are of value in the treatment of certain diseases by reason of their property of selectively fixing to the trypanosome parasite (thus poisoning its protoplasm). He then passed to consider "Bayer's 205," to which attention was recently called in these columns.[5] Though it appears to act in the same way as a dye, this substance is a colourless synthetic drug, and has remarkable properties in curing sleeping-sickness, even in cases well advanced, when previous remedies had failed. Its nature was not divulged by the Bayer firm, but researches carried out by M. FOURNEAU and co-workers at the Pasteur Institute, Paris, show it to be a salt of a complex sulphonic acid, and they have prepared and published the formula of a compound of this type (which they distinguish as "309"). If it is not identical with "Bayer's 205" it has very similar properties and probably is as valuable.

Prof. O. F. BOYD, B.A., of the Imperial College of Tropical Agriculture, Trinidad, points out[6] that the purpose of the College course in Sugar Technology, is "to train men in the manufacture of sugar in all its phases, and to give them a thorough practical and theoretical knowledge of the principal processes of fabrication." As the lectures are given, the practical accomplishment of the phases and processes discussed must be carried out simultaneously in the factory, and analyses made in the laboratory of the products, a complete routine thus being established. In fact, the experimental plant would be operated under the same conditions as a larger factory would work, especially as regards labour and fuel. A system of sugar factory book-keeping and report work will be installed similar to those in use in the most modern factories to-day. These plans offer numerous opportunities for studies and research, for which every encouragement will be given. There will be also courses on Chemical Machinery and on Agricultural Engineering. Further, a 2-year course in Spanish will be compulsory; while students will be encouraged to obtain, if possible, a working knowledge of Dutch.

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[1] *Bulletin economique de l'Indo-Chine*, 1922, 25, No. 157, 725-727; through *Rev. Int. Sci. Pract. Agr.*, 1923, 1, No 4, 1106. [2] *Chem. Metall. Eng.*, 1924, 31. 58-60.

[3] *Chemical Trade Journal and Chemical Engineer*, 1924, No. 1940, 75, 94.

[4] Presidential Address to Section I (Physiology) of the British Association, Toronto.

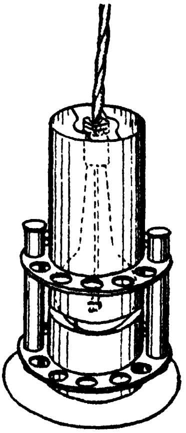
[5] *I.S.J.*, 1924, 329. [6] *Tropical Agriculture*, 1924, 1, No. 9, 131-132.

Review of Current Technical Literature.[1]

A SIMPLE TURBIDISCOPE FOR THE EXAMINATION OF SUGAR FACTORY AND REFINERY FILTRATES, ETC.

W. D Horne and E. W. Rice. Industrial and Engineering Chemistry, 1924, 16, No. 6, 626.

In examining solutions for turbidity, it is necessary to detect very faint degrees of cloudiness, if erroneous conclusions are to be avoided. The method commonly used of holding the bottle or tube of solution directly between a source of light and the eye of the observer fails to show the presence of very minute solid particles held in suspension, capable of giving more or less trouble. By employing the ultramicroscopic method of illumination, however, these extremely minute particles are caused to reflect the light from the side and transmit it to the eye of the observer, who, looking through the solution against a black background, easily detects minute reflecting particles or a faint cloud where none was seen before. But in order to examine filtrates from bag filters, filter-presses, boneblack, and other sources, a very easily built apparatus has been constructed to take advantage of these conditions. The source of light is a good, nitrogen-filled, concentrated-filament, incandescent lamp bulb, hung in a tin cylinder fitting quite closely around it and extending a little above the top of the lamp and about 1 cm. below the filament. About 1 cm. below this cylinder, a second tin cylinder is attached by three soldered wires, and both are painted black on the outside and inside to prevent dispersion and reflection. Around each cylinder is a metal annulus perforated with holes to accommodate test-tubes, while at the bottom is soldered a broader annulus of tin to serve as a support for the test-tubes. It can also serve as a base for the apparatus, but it is better to support it by the lamp socket, as illustrated, so that it can be easily turned and will be air-cooled. When the solution to be examined is put into a tube and set in the rack, there becomes apparent Tyndall's phenomenon of the reflection of light by the minute suspended particles, all viewed against a black background. The determination of turbidity can be made, quantitatively by comparing an observed sample with a tube containing a known amount of fine material in suspension. Care should be taken, however, not to compare turbidities in solutions of different degrees of colour, without taking account of the fact that faint turbidity in a nearly colourless solution may be easily visible, while an equal amount of suspended matter may be hidden in a solution containing any considerable amount of colour.



INCRUSTATION OF EVAPORATOR TUBES, DUE TO AN ABNORMAL SULPHATE CONTENT OF THE MILL JUICE.

T. van der Linden. Archief, 1924, 32 (4e deel Verslagen 1e Afl.), 31-37.

At one of the meetings of the recent Congress of Java sugar technologists, Dr. VAN DER LINDEN discussed evaporator incrustation in its relation to the presence of abnormal constituents in the raw juice. During the last clean-up at Sroenie (a defecation factory), an especially hard, glistening scale was found deposited on the tubes of the fourth body of the quadruple. It was practically impossible to remove it, either with a knife or with a chisel. Boiling out with ammonium fluoride, a device which was particularly successful on a previous occasion at a Java factory,[2] was of no avail, nor had similar treatment with 1 per cent. hydrochloric acid. Some of the scale was with difficulty collected, and a portion which had come from the interior of one of the tubes of the fourth body was analysed with the following results, expressed as percentages of the dry matter:—"Ash" (residue on ignition), 76·02; loss on ignition, 23·98; SiO_2 (after fusion with soda), 2·55; SiO_2 (insoluble in HCl), 0·11; Fe_2O_3 and Al_2O_3, 0·88; CaO, 30·13; MgO, 0·06; CO_2, absent; and SO_3, 39·15, the principal of these constituents probably existing as: $CaSO_4$,

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1923, 637.

66·56; $CaCO_3$, absent; and $CaSiO_3$, 3·45 per cent. A portion of scale taken from the upper tube-plate gave a very similar result, that is, it consisted of about 70 per cent. of calcium sulphate or gypsum, from which it cannot be wondered that boiling, either with ammonium fluoride or with hydrochloric acid, had no effect. Another deposit, however, much softer, had formed above the gypsum scale. This contained only 31 per cent. of $CaSO_4$, and apparently had represented the layer deposited when normal juice was being obtained in the mill. Neither the lime nor the maceration water used could be blamed for the introduction of the sulphates (their SO_3 content being 0·15 and 0·058 per cent. respectively). Only, therefore, by the raw mill juice could this constituent enter the factory; and some of the results obtained on analysing the juice from a number of different canes showed the following sulphate (SO_3) contents:—E K 28 Gen., 0·063 to 0·163; E K 28 B.I., 0·112; D I 52 B.I., 0·121; 247 B.I., 0·112 to 0·207; and 2725 Gen., 0·189, that is, on the whole, a considerable variation, viz., from 0·063 to 0·207 per cent. As a means of lessening trouble from this source, as much as possible, it is therefore suggested that, at the commencement of the season, cane of low SO_3 content should be ground,[1] so that the clean tubes of the evaporator become coated with a deposit which can be detached without much difficulty. Later the cane with a high SO_3 content could be worked, when the hard gypsum scale would be deposited upon the softer material, so that the entire coating on the tube could be detached without any unusual difficulty. It is conjectured that this high SO_3 content of raw juice may be due to the accumulation of this constituent in the soil, resulting from the continued use of ammonium sulphate as fertilizer, though this is a matter yet to be investigated.

ADOPTION OF THE MILLILITRE IN PLACE OF THE C.C. FOR THE STANDARDIZATION OF VOLUMETRIC GLASSWARE. Anon. *Report issued by the Joint Committee for the Standardization of Scientific Glassware, 30, Russell Square, London, W.C.1.*[2]

A Joint Committee, acting under the ægis of the Institute of Chemistry, London, and representing users, manufacturers, Government Departments, and other bodies concerned with scientific glassware has unanimously recommended: *That the recognized international metric units—the "litre" (l) and "millilitre" (ml.) or thousandth part of the litre—shall be used as the standard units of volume, and that standard volumetric glassware shall be graduated in terms of these units and marked "ml." instead of "c.c."*

The acceptance of this recommendation by chemists and manufacturers of glassware would bring the practice in this country into line with that in other countries, notably America, and would give effect to the recommendation of numerous scientific bodies that the litre, as defined below, should be exclusively used as the unit of volume in all scientific work. Publication of all results in terms of millilitres would secure a uniformity which is at present lacking, and remove the uncertainty due to the term c.c. being used sometimes correctly, sometimes as equivalent to the millilitre, and sometimes as the space occupied, under conditions not generally well defined, by a quantity of water which has an apparent weight in air of 1 grm. Moreover, the substitution involves no practical difficulties, as the two units differ only very slightly in magnitude. Some chemists, however, will still prefer to use Mohr's system of units of volume; and the Committee have therefore felt it desirable to couple with the above recommendation the following proposals:—(1) That the unit of volume on Mohr's system shall in future be designated "G.W.A,"[3] and that these letters shall be marked on all volumetric glass vessels graduated on the basis of Mohr's system, and shall be used by chemists when reporting results obtained by the use of such vessels; and (2) that the "G.W.A." unit shall be defined thus: 1000 G.W.A. = 1002 ml.

These additional recommendations will enable the two systems to be used side by side with a minimum of inconvenience during the transitional period preceding the universal adoption of the litre and millilitre for general chemical work. It is explained that the accepted definition of the litre at the present time[1] is the volume occupied by a mass of 1 kg. of pure water at its temperature of maximum density and under normal atmospheric pressure. On the other hand, the c.c. is simply the volume of a cube whose edges are 1 cm. long. Therefore, the c.c. is completely defined without any reference to the litre, and no direct relation between the two units results from their definitions. This relation can only be found by direct experiment, and the most accurate determination available is that carried out at the Bureau International des Poids et Mesures, the value being given by M. Benoit[2] in his summary of the work as: 1 litre = 1000·027 c.c. It is therefore seen that the difference between the ml. and the c.c. is so small as to be negligible for ordinary volumetric glassware, the difference in capacity between a litre flask, for example, and a 1000 c.c. flask being little less than the observational errors liable to arise in the ordinary use of either vessel. It must be remembered that the use of the term "c.c." by users of the Mohr's system to denote the volume of a quantity of water having an apparent weight in air of 1 grm. is a misapplication, and to speak of a 1000 c c. flask so standardized is inadmissible. Actually, it has a capacity of 1002 c.c.

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[1] A method for the determination of the sulphate content of raw juice was recently described by EGETER. See *I.S.J.*, 1924, 447.

[2] Copies of this Report, entitled "Units of Volume," are obtainable on application to the Secretary of the Joint Committee, price 6d., address as above stated.

[3] A mneumonical abbreviation for "grammes of water in air."

Value of the Determination of the Surface Tension of Sugar Factory Products.

K. R. Lindfors. Industrial and Engineering Chemistry, 1924, 16, No. 8, 813-816.

An abstract of this paper read before the 67th Meeting of the American Chemical Society[3] has already appeared, and it is now possible to add some details to the general information already communicated. Gums or emulsoids have a strong depressing effect on the surface tension of sugar solutions, whereas the presence of mineral salts on this determination is practically negligible. It would seem, therefore, that this determination may furnish some indication of the colloidal impurities present in a sugar product. Using du Noüy's apparatus (based on the static method), the following values were found : sugar (10 per cent. solution), 76 dynes ; gum arabic (0·5 per cent. solution), 62·1 ; potassium carbonate (1·5 mols per litre), 79·9 ; molasses (25 per cent. solution), 42·1 ; the same liquid after filtration, 47·6 ; beet evaporator syrup, 51·1 ; the same after filtration, 54·5, diffusion juice which has been heated and filtered, 63·0 ; the same after removal of the gums (by carbon), 66·0; artificial beet juice (made from molasses and granulated sugar), 59·3 ; and the same after being limed and carbonated, 64·9. It is believed that this determination may furnish a means of some value in control work for immediately showing any irregularities in the sugar factory or refinery, since, using the apparatus, a determination can be done in less than one minute. Other directions in which it may be of great possible value are: for judging the keeping quality of a sugar (the higher the tension the smaller the moisture absorption) ; for differentiating between granulated beet sugar, plantation white, and refined (the first having a value of 70-74 and the second one of 62-68) ; for estimating the purifying value of boneblack (animal charcoal) and activated carbon ; and for determining the comparative refining values of raw sugars which apparently are similar. This subject represents a virgin field for research in the sugar industry, and it is believed that its development may yield results of some considerable practical value.

Determination of the Ash Content of Molasses with the Addition of Magnesium Oxide.

C. Franz Pachlopnik. Zeitsch. Zuckerind. Czecho-Slov., 1924, 48, No. 44, 417-419.

When magnesium oxide is added to the assay material previous to incineration for the determination of the ash, burning is readily accomplished, a white, porous residue being left behind, and the following procedure is therefore prescribed: 2 grms. of molasses are weighed into a platinum dish provided with a stirring rod, mixed with about 0·6 c.c. of distilled water, and about 1 grm. of magnesium oxide well incorporated with the mass, after which the dish is re-weighed, and incineration effected during three-quarters of an hour in an electric muffle at a temperature of 700° to 750°C. Previously, the magnesium oxide should have been heated in the muffle at the same temperature until its weight is constant, being then placed in a bottle provided with a rubber stopper, and cooled while still hot in a desiccator. Results were obtained checking closely with those found by the so-called carbonate method of direct incineration ; but no figures are given to show a comparison with the usual sulphate procedure. A point investigated was whether either the heat-resisting glass known as "Resista" or porcelain could serve as the material for the incineration basin, but both materials were attacked under the conditions mentioned, though the ash had shown no sign of melting. Since magnesium oxide is a little hygroscopic, an attempt was made to replace it by the use of "Carborundum," "Elektrit" or aluminium oxide, calcined, but in no case was it found possible to reach a constant weight on heating to the degree mentioned.

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[1] *Trav. et Mem.*, Vol. 12, 1920. [2] *Ibid.*, Vol. 14, 1910. [3] *I.S.J.*, 1924, 313.

DEHYDRATED [ABSOLUTE] ALCOHOL FOR USE AS MOTOR FUEL.

H. Guinat. *Sucrerie, Distillerie, Industries Agricoles*, March, 1924, page 17.

This is an explanation of the modern method of obtaining absolute alcohol by the principle of ternery mixtures of minimum boiling points, which easily permits of the removal of the last traces of water by the addition of a certain proportion of benzol to the aqueous mixture.[1] This, in fact, appears to be the only process that has survived the test of economic practice for the production of 99-100 per cent. spirit. It is possible to operate the method with ordinary modern rectifying equipment to which two small columns and one decanter have been added. Particulars of steam consumption and yields from experience gained at the Deux-Sèvres distillery (France), with which the author is connected, are stated.

DETERMINATION OF RAFFINOSE IN BEET SUGARS AND BEET MOLASSES.

Émile Saillard. *Supplement à la Circulaire du Comité Central des Fabricants de Sucre de France, No. 1841 of 1924.*

When CLERGET elaborated his double polarization method in 1838, he knew nothing of raffinose, and no formula has hitherto been adapted to the calculation of the trisaccharide when following his procedure. A suitable one has, however, now been worked out by the author. He found that whereas the rotation of a normal solution (containing 16·265 grms.) of pure sucrose, hydrolysed under the Clerget conditions, and observed at 20°C. is — 34·00°, that of solutions of raffinose containing 7 to 10 grms. is after hydrolysis + 51·56 per cent. of the direct reading. Therefore if S is the sucrose content ; R the content in raffinose ; D the direct polarization ; I the inversion polarization ; and C the sum of $D + I$ (when I is levo-rotatory), then $D = S + R$; and $I = -0{\cdot}34S + 0{\cdot}5156R$; from which $S = C - 0{\cdot}4844\ D/0{\cdot}8556$; and R (raffinose hydrate) is $D - S/1{\cdot}57$. In order to test this formula, a solution containing 16·265 grms. of sucrose and 1·99 of raffinose per 100 c.c. was analysed by determining the direct and inversion readings, and calculating S and R by the formulæ just stated, when the quantities of sucrose and raffinose mentioned were indicated as the result. In regard to the difference between the direct polarization and the sucrose calculated from the original Clerget formula, this averaged 0·53 for 1911-12 (a dry year), while for 1923-24 it was 1·44, the nitrogen content being 2·65 and 2·15 per cent. of the two seasons respectively. Sometimes, however, in 1923-24 the difference rose even to 3 without the nitrogen content having varied much. This difference between the direct polarization and the calculated sucrose content appears to be due to some extent to the presence of nitrogen, but more to the raffinose, though there are probably other factors as well. There is reason to believe that raffinose forms to a greater extent during the later growth of the beet in the field, and during the time that the roots are lying in the silos previous to entering the factory.

EXTRACTION OF SUGAR FROM (BEET) MOLASSES BY THE FRIEDRICH AND RAJTORA PROCESS.

Émile Saillard. *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France, Nos. 1836* and *1843.*

For this recently patented process is claimed : A yield of 75–80 per cent. of the sugar present in the molasses ; inexpensive installation (extra tank and crystallizer capacity only being required); inexpensive operation (the reaction taking place in the cold); rapid working (2-3 hours); and the recovery of the mother-liquors in a marketable form. It consists simply in mixing acetic acid with the molasses, the addition of a catalyst, and the resulting precipitation of the sugar in a curable form, the final liquors being subsequently worked up for the recovery of the potash and nitrogen, as well as for the acetic acid remaining in them. According to a balance-sheet prepared by the inventors showing the profits likely to accrue, on the debit side there are 7000 tons of molasses at 125 francs, 875,000; 294 tons of acetic acid at 4000 francs, 1,176,000; 5 tons of benzol at 1050 francs, 5250; labour, 10 workmen earning 20 francs daily or annually, 72,000; coal for the re-distillation of the acetic acid, 280 waggons at 1000 francs, 280,000; sinking fund, repairs, and various charges, 165,000, a total of 2,575,250 francs On the credit side, there stands a recovery of 70 per cent. of sugar, i.e., 2450 tons at 1300 francs, 3,185,000; 4300 tons of mother-liquors at 120 francs, 537,500; and nitrogen, 84 tons at 40 francs, 3360; a total of 3,725,860, leaving a possible profit from the annual operation of 7000 tons of molasses of 1,152,610 francs, without any deduction for the acetic acid recovered, which, it is considered, might be done with a loss of only 5-7 per cent. on the technical scale. In order to obtain some indication of the value of the process, Mr. SAILLARD has carried out some laboratory experiments. Molasses was concentrated to a water content of 20 per cent, cooled, mixed in three tests with 45, 60 and 75 per cent. of acetic acid (glacial), and the mixture stirred from time to time. After two hours, crystallization had occurred, and after 24 hours the sugar was separated on a filter-funnel, analyses of the original molasses and of the resulting mother-liquors showing that about 75·50, 78·5 and 80·7 per cent. respectively, for the quantities of acetic acid mentioned had thus been recovered. In other experiments, dilute acetic acid was distilled, and the concentration of the various fractions was noted, when it was found that the loss on the laboratory scale is about 20 per cent. In the Nestomitz factory-refinery, Czecho-Slovakia, where the process was in operation, Mr. SAILLARD saw that the molasses was evaporated to a water content of 5 per cent., that 60 per cent. of acetic acid was added, and that the sugar was separated in centrifugals provided with a rather fine lining, the yield then being, according to Mr. RAJTORA, 70-75 per cent. of that originally present. As to the acetic acid recovery from the liquors, at the time of Mr. Saillard's visit this recovery was not being effected. Nothing is said in regard to the identity of the "catalyst" mentioned above.

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[1] A number of patents for modifications of this principle have been recently taken out, as will be seen in our Review of Recent Patents for the last few months.

REGENERATION OF FEHLING'S SOLUTION FROM THE FILTRATE RESULTING FROM THE DETERMINATION OF REDUCING SUGARS.

C. Leo Pick. Zeitsch. Zuckerind. Czecho-Slovakia, 1924, 48, No. 45, 425-428.

Sometimes in laboratories using much Fehling's solution, the blue filtrates are collected, and periodically treated for the recovery of the copper sulphate still remaining in them, but hitherto no one appears to have suggested a method for the regeneration of the entire reagent, that is of both the blue and the white solutions. A procedure of doing so has, however, now been worked out by the author, who recommends operating as follows, potassium bitartrate (not Rochelle salts, potassium-sodium tartrate) being recovered: Filtrates (excluding the wash-waters) from the determination of reducing sugars by the use of Fehling's solution are collected in a large container (provided with a tightly closing stopper) and the copper present in them thrown down as cuprous oxide by treatment in the cold with invert sugar, using for 6 litres 10 grms. of sugar which has been hydrolysed by boiling with 1 : 50 hydrochloric acid. After separating the cuprous oxide by passing the subsided portion of the liquid through a double filter-paper on a Buchner funnel, it is dissolved in an excess of sulphuric acid in contact with air, and the solution of cupric sulphate concentrated and allowed to crystallize. Then to the boiling filtrate is added dilute sulphuric acid until neutrality to litmus paper is reached, following which the amount of sulphuric acid necessary to liberate the potassium bitartrate is ascertained. This is done by determining the SO_3 in two portions; first, 25 c.c. of the neutralized liquor as it is; and, second, also in 25 c.c. after evaporating it down with sulphuric acid and igniting at a moderate temperature, the increase in SO_3 corresponding to the alkalis combined with tartaric and the other organic acids present. This amount of SO_3 is calculated to H_2SO_4, but, as the bitartrate is to be formed, only half this amount of sulphuric acid is added.[1] After the addition, the liquor was "seeded" with a crystal or two of potassium bitartrate, and allowed to stand over-night, the salt crystallizing out being separated on a Buchner funnel, washed with a little cold water, and dried, the yield obtained being 86·6 per cent. of the theoretical amount. Then some Fehling's solution was prepared by dissolving 34·64 grms. of the recovered copper sulphate to 500 c.c. for the blue solution, and 116 grms. of the recovered potassium bitartrate and 75 grms. of pure sodium hydroxide also to 500 c.c. for the white liquor, a reagent thus being obtained which gave exactly the same copper reduction as that prepared from purchased reagents of standard purity. It is believed preferable to use potassium bitartrate instead of Rochelle salts for the preparation of Fehling's solution, not only on economical grounds, but also because it is ordinarily obtained in a higher degree of purity. An alternative method of procedure for determining the amount of sulphuric acid necessary for the crystallization of the potassium bitartrate is, using 50 c.c. of the neutralized liquid, to add 2 c.c. of acetic acid (glacial), allow it to stand for 48 hours (seeding with a minimum amount of bi-tartrate crystals), to filter, wash, and titrate with N/10 alkali. Then the amount of bitartrate thus found, added to that remaining in the solution (0·4 grm. per 100 c.c), is treated with 1·4 times of sulphuric acid theoretically necessary for the liberation of potassium bitartrate.

UNITED STATES PATENTS ON BONEBLACK (ANIMAL CHARCOAL) AND DECOLORIZING CARBONS. *W. D. Horne. Industrial and Engineering Chemistry, 1924, 16, No. 7, 670.*

Black pigment: 148,778 ; *Boneblack composition* : 122,526 ; *Boneblack driers*: 329,324 ; 335,137 ; 335,586 ; 341.497 ; 343,666 ; 749,723 ; 769,421 ; 871,705 ; 984,931 ; 1,058,369 ; *Boneblack manufacture*: 153,741 ; 155,919 ; 165,344 ; 178,315 ; *Charcoal furnace* : 12,602 ; *Chemically treating boneblack* : 831,805 ; 1,177.725 ; *Collecting ammonia from char* : 287,570 ; 297,948 ; *Cooling boneblack* : 61,851 ; 68,915 ; 77,935 ; 93,208 ; 101,019 ; 186,327 ; 199,118 ; 278,356 ; *Decarbonizing boneblack* : 530,632 ; 585,658 ; 586,278 ; 592,547 ; 1,184,397 ; *Decolorizing carbons* : 739.104 ; 1,133,049 ; 1,135,216 ; 1,151,553 ; 1,195,720 ; 1,200,713 ; 1,219,438 ; 1,249,041 ; 1,250,228 ; 1,251,546 ; 1,262,770 ; 1,286,187 ; 1,287,592 ; 1,290.002 ; 1,308,826 ; 1,314,204 ; 1,358,162 ; 1,359,094 ; 1,362,064 ; 1,368,987 ; 1,383,755 ; 1,385,826 ; 1,396,773 ; 1,402,007 ; 1,413,446 ; 1,438,113 ; 1,440,194 ; *Discharging devices* : 254,474 ; 257,114 ; 268,981 ; 335,586 ; 351,929 ; *Filter discharges* : 329,305 ; 335,602 ; 335,603 ; *Furnaces and kilns* : 35,212 ; 88,700 ; 88,701 ; 88,702 ; 89,492 ; 173,989 ; 178,286 ; 221,725 ; 236,458 ; 265,876 ; 303,378 ; 303,379 ; 308,476 ; 314,866 ; 316,610 ; 320,110 ; 337,411 ; 345,324 ; 345,968 ; 407,912 ; 407,976 ; 412,781 ; 414,608 ; 523,248 ; 556,603 ; 557,498 ; 584,071 ; 612.319 ; 624,510 ; 638,177 ; 708,898 ; 796,303 ; 940,520 ; 972,023 ; 978,625 ; 1,004,176 ; 1,160,657 ; *Oxidizing charcoal or char* : 429,682 ; 526,180 ; 538,028 ; 617,080 ; *Recarbonizing boneblack* : 509,460 ; 530,632 ; *Refining substances* : 1,435,972 ; 1,442,372 ; 1,447,452 ; 1,448,846 ; *Retorts* : 587,057 ; 644,507 ; 796,304 ; 851,409 ; 912,644 ; *Revivifying boneblack* : 22,734 ; 26.457 ; 27,462 ; 32,679 ; 35,160 ; 36,230 ; 39,637 ; 39,638 ; 40,371 ; 47,308 ; 53,534 ; 54,771 ; 60,492 ; 62,537 ; 62,927 ; 65,389 ; 65,457 ; 65,597 ; 68,915 ; 77,935 ; 93,668 ; 96,899 ; 113,279 ; 114,780 ; 134,686 ; 150,821 ; 161,253 ; 165,992 ; 167,235 ; 178,286 ; 179,579 ; 188,006 ; 188,029 ; 190,676 ; 235,942 ; 249,004 ; 260,486 ; 265,723 ; 279,335 ; 293,430 ; 350,170 ; 450,209 ; 1,189,896 ; 1,184,398 ; 1,207,178 ; *Revivifying decolorizing carbon* : 1,074,337 ; 1,189,896 ; 1,269,080 ; 1,326.159 ; 1,327,222 ; 1,423,231 ; 1,440,095 ; *Steaming boneblack* : 194,256 ; 239,962 ; 320,110 ; 391,335 ; 447,313 ; 526,180 ; 947,503 ; *Sugars and boneblack filters and filtration* : 13,740 ; 329,184 ; 329,185 ; 329,210 ; 329,306 ; 329,329 ; 329,330 ; 329,332 ; 335,622 ; 335,763 ; 340.005 ; 961,180 ; 1,430,200 ; *Washing boneblack* : 263,710 ; 360,581 ; 529,469.

J. P. O.

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[1] In the case of an example given, 62·6 grms. of sulphuric acid of 98 per cent. was the amount added for 5·8 litres of liquid.

Review of Recent Patents.[1]

UNITED KINGDOM.

TOOTHED ROLLERS FOR CRUSHING AND SHREDDING CANE. *Francis Maxwell*, of 11, Park Avenue, Wallington, Surrey. *217,310.* March 12th, 1923.

This invention relates solely to toothed rollers for crushing and shredding sugar cane of the type in which the rollers are provided with longitudinal grooves and the teeth are attached to the rollers by keys or the like driven in or by pouring molten metal into the grooves. The teeth are formed on bars or segments which rest on the periphery of the roller and cover the whole or nearly the whole of the periphery. Referring to the drawings, Fig. 1 is a part section of a roller provided with teeth in accordance with this invention ;

Fig.1.

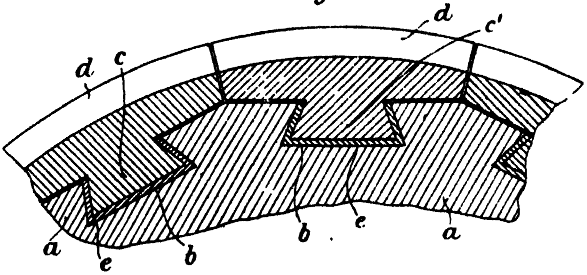


Fig.2.

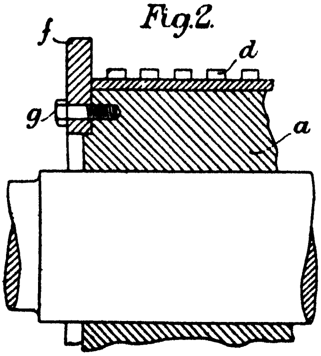
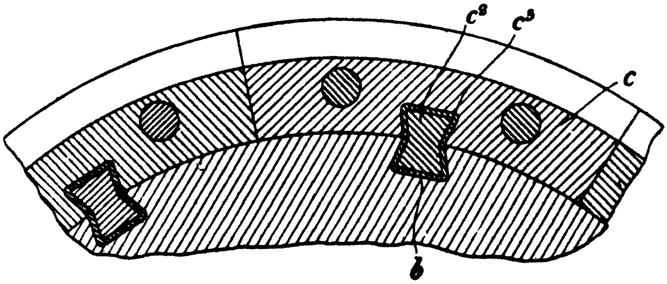


Fig.3.



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

Fig. 2 is a side elevation of a part of the roller showing a flange at the end of the roller; Fig. 3 is a part section showing a modified construction. Roller *a* has grooves *b b* formed in it longitudinally and parallel to the axis. The bars *c* on which the teeth *d* are formed rest on the periphery of the roller and cover the whole or nearly the whole of the periphery. On the bars are projections c^1 which lie in the grooves *b* and are secured in position by white metal run in at the side of the grooves or by means of keys or by being made a suitable fit and pressed or driven in. The bars *c* are further secured to prevent longitudinal movement by plates or rings *f* at the ends of the roller, the plates or rings being secured to the roller by set screws *g* or by other suitable means. In the form shown in Fig. 3 a key c^2 is disposed in the groove *b* in the roller and in a groove c^3 in the bar *c* on which the teeth are formed. In use when the teeth become worn, the bars can be taken out and new bars substituted without the necessity of renewing the whole roller.

* * *

Disintegrating Crystalline Material, especially Sugar. *James L. Fairrie*, of 21, Victoria Street, Liverpool. *213,970.* January 9th, 1923.

This inventor states he has found that "if raw or incompletely refined sugar is very finely divided, its appearance may be greatly improved without solution and re-crystallization or the like, and especially as regards lightening its colour and increasing its blending powers." Such a product, he believes, to be novel. Accordingly, he disintegrates the crystalline material in a machine which is artificially cooled well below atmospheric temperature, and preferably below 0°C. As one example of the invention, a conical grinding mill (in which a serrated cone engages within a conical grinding surface) may be artificially cooled to 10°C., or even lower, by a cooling jacket within which cold brine (or other suitable medium) circulates. Brown sugar is fed from a hopper through a sealed valve into a worm conveyor, which is also jacketted and cooled below 0°C. The cooled sugar is passed through a cooled chute into the cooled mill. Air is excluded sufficiently to prevent deposition of moisture on the cooled sugar. Disintegration by impact, or other means of pulverization may be used in this invention in place of grinding. Claim 7 of this specification reads as follows:—"Brown sugar in the form of a powder in which the particles are much smaller than the original crystals which powder is much lighter in colour than the original crystals when prepared or produced by the special methods or processes of manufacture described and claimed."

Clarification and Decolorization Process for the Manufacture of Direct Consumption Sugar.[1] *Joseph J. Ragg*. *219,194.* August 25th, 1923.

Claim is made for a clarification and decolorizing process for the manufacture of white sugar, comprising first clarification by the addition and admixture of a cold saturated aqueous solution of lime and sufficient finely powdered lime to make a saturated solution with the water contained in the whole body of the liquid at ordinary temperatures and of a sp. gr. between 1035 and 1040; and, second, the decolorization of the hot clarified juice and solution of lime by constant agitation together with powdered animal charcoal (boneblack). Also for the process of complete filtration after decolorization with animal carbon of the hot juice and solution of lime to produce a clear white liquid, free from any particles of carbon, and ready for immediate transfer to the evaporators in the ordinary course of manufacture of white sugar, by percolation through a layer (suitably supported) of wet, pure, light carbonate of magnesia. Claims are further made for the apparatus described for realizing clarification and decolorization in the manner divulged, as well as for the apparatus for effecting the complete filtration of the juice.

* * *

Animal Charcoal (Boneblack) and Decolorizing Carbon. *W. D. Horne. Industrial and Engineering Chemistry*, 1924, *16*, No. 7, 670.

This is a full list of U.S. patents on animal charcoal (boneblack) and decolorizing carbon,[2] arranged under specific headings, and according to serial number.

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[1] For a description of this process see *I.S.J.*, 1924, 497.

[2] See *I.S.J.*, 1924, 559.

FRANCE.

Plant for the Extraction of Juice from Beet or Cane by Diffusion. *Georges Chevraux.* *550,148.* August 21st, 1921; published, February 27th, 1923.

This patent relates to a method of laying out the diffusion plant, claimed to realize important economies in respect of space, building construction, wages, etc. According to the scheme described (for details of which the original specification should be consulted), the extracting plant consists of the usual series of circular diffusion vessels, with the necessary juice and water connexions and other accessories; but these are placed in a pit of concrete below the level of the ground, the slicing and pressing apparatus being on the ground level of the factory. Running in a line directly above the series of tanks is a travelling crane or similar arrangement. Each of the vessels is charged by lowering into it by means of the travelling crane a circular basket containing the fresh slices; while at the end of the operation the basket is lifted out of the vessel and carried along to the slice-presses.

GERMANY.

Operation of the Diffusion Process for the Extraction of Sugar from Beets. *Hermann Steckhan*, of Rastenburg, Germany. *375,636.*[1] September, 16th, 1920; published, May 16th, 1923.

A process of operating diffusion has previously been described according to which two lots of juice are withdrawn from the third cell of the battery, the first being passed into manufacture, while the second is used for displacing the juice in the second cell for mashing in the first: but in this invention the charge of juice extracted from the cell in which mashing has just been effected is mixed in a pre-heater with the second withdrawal from the third cell, and this mixture only is used for displacing the mashed juice from the second into the first cell.

Electrolytic Production of Hydrosulphites. *Badische Anilin- & Soda-Fabrik*, of Ludwigshafen a. Rh., Germany. *370,722.* December 4th, 1921; March 16th, 1923.

Claim is made for a process for the electrolytic production of hydrosulphites from solutions of bisulphites characterized thereby that the electrolysis is carried on without diaphragms in the presence of an excess of bisulphites or sulphites.

Apparatus Regulating the Addition of Milk-of-Lime. *Jan Plapis*, of Przeworsk, Poland. *378,890.* July 2nd, 1922. Horizontal Vacuum Apparatus or Crystallizer. *Hermann Steckhan.* *377,457*; addition to *375,448.* April 26th, 1921. Process for the Biological Purification of Beet Factory Waste-Waters, using Waste Heat. *Herbert Stentzel*, of Einbeck, Germany. *342,040.* March 27th, 1920. Vacuum Crystallizer. *Société Générale d'Evaporation Procédés Prache & Bouillon*, of Paris, France. *374,763.* July 2nd, 1920. Electrical Heating of Liquids (e.g., in Evaporation or Boiling). *Badische Anilin- & Soda-Fabrik*, of Ludwigshafen a. Rh., Germany. *376,611.* January 7th, 1920. Apparatus for the Continuous Extraction of Plant Slices (e.g., Beet). *Eduard Vater*, of Magdeburg-Sudenburg, Germany. *329,057.* November 15th, 1919. Discharge of Extracted Slices from Diffusion Vessels. *Hans Mathis*, of Ottleben, Germany. *392,452.* August 29th, 1922. Beet Slice Press. *A. W. MacKensen Maschinenfabrik & Eisengiesserei G. m. b. H. and Arthur Kramer*, of Magdeburg, Germany. *385,631*; *385,634.* August 26th, 1922. Centrifugal for Covering Sugar with Steam. *Heinrich Hoeber*, of Wismar, Germany. *385,932.* December 15th, 1922.

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[1] Also French Patent, 555,140.

UNITED STATES.

TRANSMISSION GEAR FOR MANUALLY-CONTROLLED CANE CUTTERS. *Alfred W. Dunn*, of Honomu, T.H., and *Gurdon Potter*, of San Francisco, Cal., U.S.A. *1,478,327*. December 18th, 1923.

A manually controlled cane cutter has been described by the inventors,[1] and the present specification discloses a self-contained transmission gear which may be readily bolted to the forward end of an ordinary passenger automobile, to be driven by the crank shaft of the engine with a control clutch lever for operatively connecting or disconnecting the transmission, accessible to the driver in the automobile. Claim 4 reads as follows:—An auxiliary transmission gear box adapted to be secured transversely to the forward end of an automobile, a central power shaft projecting therefrom adapted for connexion to the automobile engine shaft, a plurality of power delivery shafts operatively connected to the power shaft projecting forwardly from the box with universal couplings thereon, a series of tubular standards adjacent the box, a pulley carried by each standard, weights loosely disposed within the standards, and flexible devices secured at one end each, respectively, to the weights passing over the pulleys with the other ends supporting, respectively, the power delivery shafts beyond the universal joints.

EVAPORATOR, PROVIDING MEANS FOR CONTROLLING THE FLOW FROM ONE BODY TO THE NEXT. *William H. Johns*, of Kingsport, Tennessee, U.S.A. *1,490,743*. April 15th, 1924.

Objects of this invention are: (1) to provide means for maintaining the desired height of liquid within the pans for operation, irrespective of the vacuum in each, which may vary as circumstance requires; and (2) to provide improved means whereby the last effect may be wholly emptied of the contents without producing any result in the preceding effects until such emptying has been accomplished, whereupon the last will be automatically filled from the preceding effects.

As shown in Fig. 1, the first effect is connected with the supply line through the feed pump *10*, controlled from the pipe *11* and steam line *12*. The liquid level in effect *1* is maintained by the liquid introduced by the pump *10*. This is controlled by means of a float tank *13* in communication with effect *1* through pipe *14*. Within the float tank *13* the float *15* is provided having a stem *16* upon which an arm *17* is adjustable by mean of the set screw *18*. The arm *17*, through the link *19* and lever *20* controls a valve *21* by which steam is admitted to the pump *10* for starting and stopping the pump to fill the first effect. As the liquid level in the first effect rises and falls, the liquid in the float tank *13* maintains a similar level by reason of a vent pipe *22* communicating with the top of said effect. The rise and fall of the float *15* opens and closes the valve *21* to start and stop the pump to fill the first effect. Extending between the first and second effects is a transfer pipe *23* having a valve *24* for controlling the flow through said transfer pipe. The several effects are under vacuum through their several pipes 1 ft., 2 ft., 3 ft., and 4 ft. respectively, the vacuum increasing, of course, in the usual well known manner. The maintaining of the higher vacuum in the effect *2* results in drawing material from the effect *1* through the transfer pipe *23* into the effect *2* when the valve *24* is open. The valve *24* is controlled by means of a float *25* in the float tank *26*, which communicates with the effect *2* by means of the pipe *27*. The float *25* is provided with a stem *28* having an adjustable arm *29* actuating a walking beam *30*. The walking beam *30* connects adjustably with the link *31* which controls the valve *24*. As the liquid level in effect *2* rises and falls, the float *25* responds thereto, opening and closing the valve, the opening taking place when the liquid level in effect *2* falls below the desired height. The opening of this valve *24* and the excess vacuum in effect *2* causes the inflow of material from the effect *1* to the effect *2* until the desired liquid level has been obtained, when the valve *24* is automatically closed, discontinuing the inflow through the pipe *23*. The withdrawal of liquid from effect *1* to fill effect *2*, lowering the level therein, will cause the starting of the pump to raise the level in effect *1*, as hereinafter described. Between effects *2* and *3* a transfer pipe *32* is controlled by a valve *33* and float tank *34*, the same as described in regard to the float tank *26* and valve *24*. Also between the effects *3* and *4* a transfer pipe *35* is controlled by a valve *36*. The float tank *37* communicating with the effect *4* through the pipe *38*, however, performs double function. The effect *4* is discharged through the pipe *39* and pump *40*, which pump is controlled by steam through the pipe *41* from the

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[1] Co-pending application, filed October 24th, 1921. Serial No. 509,833.

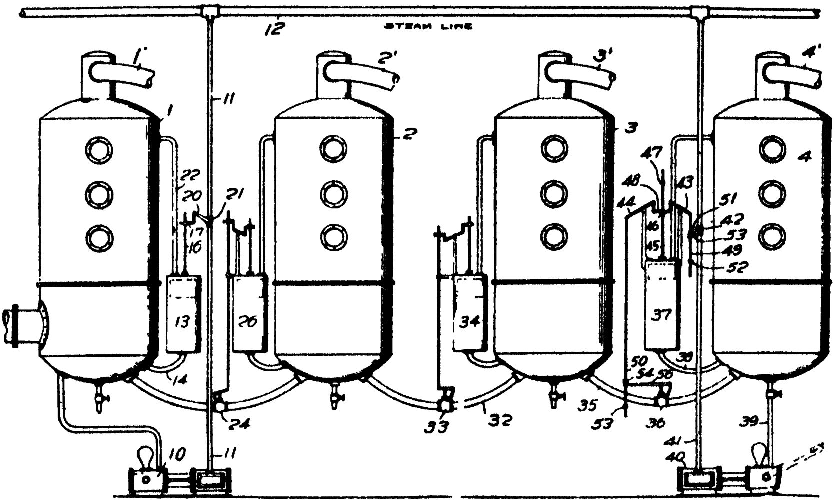

Fig. 1.

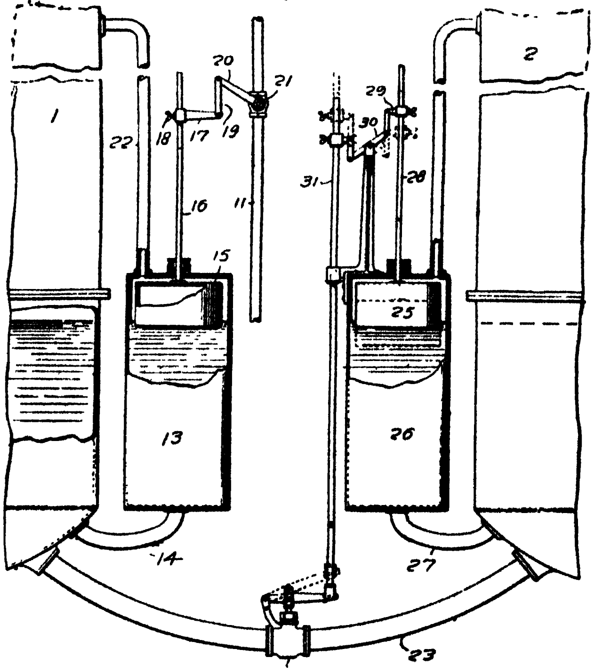

Fig. 2.

steam line *12*. The passage of steam through the pipe *41* is controlled by the valve *42*, which is, in turn, controlled by the walking beam *43*. The valve *36* is controlled by a walking beam *44* and both these walking beams are controlled by the stem *45* from the float in float tank *37*. As it is desirable to completely empty the fourth effect before admitting fluid from the third effect, the float stem *45* does not actuate the members as in the other effects. The stem *45* is provided with spaced collars *46* and *47*, actuating a cross-head *48* only when the float within the tank *37* has fallen or risen to such a point that the collars engage said cross-head. The cross-head *48* rocks the walking beams *43* and *44* respectively, which in turn actuate links *49* and *50*. The link *49* is provided with spaced collars *51* and *52* which engage the lever *53* of the valve *42*, whereas the link *50* is provided with spaced collars *54* and *55* which engage the lever *56* of the valve *36*.

Operation of the device is as follows: The first effect is filled by the pump *10* actuated by steam from the line *12* until the desired liquid level has been obtained within such effect. Assuming the second effect to be empty, the valve *24* will be opened and the material from the first effect will flow into the second effect until the valve *24* is closed. In the usual operation of the device, all the effects are normally filled to the required liquid level, but as the liquid level is lowered by evaporation the valve feeding such effect is automatically opened admitting liquid from the prior effect. As the vacuum in each effect is greater than the vacuum in the preceding effect, it will draw the fluid through so that to and including the filling of the fourth effect the action is wholly automatic. It is intended that substantially the required degree of concentration shall take place in the first, second, and third effects and that the concentrate shall enter the fourth effect in very nearly its concentrated condition and that the fourth effect shall act largely as a trap for discharging the material from the battery of effects, although it is obvious that a certain amount of evaporation will also take place in the fourth effect. The concentrate from the third effect will pass through the pipe *35* and the valve *36* into the fourth effect, and by raising the level in such effect and the connexion of the cylinder *37* thereof will raise the float in the cylinder *37* until the stop *46* upon the rod *45* engages the cross-head *48* and tilts the walking-beam *44* to such an extent that the collar *54* of the rod *50* will actuate the lever *56* to close the valve *36*. The upward movement of the cross-head *48* also tilts the walking-beam *43* and until the collar *51* engages the lever *53* to such an extent as to open the valve *42*, the opening of the valve *42* being intended to be substantially simultaneous with the closing of the valve *36*, the opening of the valve *42* supplies motive power to the cylinder *40* to actuate the pump to withdraw the contents from the fourth effect. As the contents is being withdrawn, the float of the cylinder *37* falls until the collar *47* engages the cross-head *48* and the continued fall tilts the walking-beams *43* and *44*, lifting the rods *49* and *50*. This lifting is continued until the collars *52* and *55* respectively engage the levers *53* and *56*, whereupon the valve *42* is closed and the valve *36* opened. The rarification in the fourth effect being greater than the third effect, the material in the third effect is thereby drawn through the pipe *35* and the action is intermittently repeated. The collars *46*, *47*, *51*, *52*, *54* and *55* are all made adjustable upon their separate rods so that they may be timed to operate exactly in unison or at such different intervals, either individually or in unison as may be found desirable. Adjustment of the collars upon the rods *49* and *50* is only auxiliary to the adjustment of the collars upon the rod *45*. Each effect is dependent for its action upon the subsequent effect, whereby the first effect is constantly filled by the pump *10*, and the fourth effect emptied by the pump *40*, the intermediate effects being automatically filled to the requisite level by the rise and fall of their respective floats and the valve constructions operated thereby.

GUIDE-KNIFE (TRASH-TURNER) FOR CANE MILLS. *John P. Golden* (Assignor to *Golden's Foundry & Machine Co.*, of Columbus, Georgia. U.S.A.). *1,485,386*. March 4th, 1924.

Claim 3 reads as follows :—"In a cane mill, the combination with framework and three rolls, one of said rolls having flanges adjacent its ends, of a reversible guide-knife structure having opposite heads providing, interchangeably roll engaging portions, disposed between two of said rolls and having flanges entering between the flanges of the other roll, and means for adjustably supporting said guide-knife structure."

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th.		Nine Months ending September 30th.	
Unrefined Sugars.	1923. Tons.	1924. Tons.	1923. Tons.	1924. Tons.
Poland	....	1,646	5,914	25,072
Germany	....	....	1	.
Netherlands	....	....	14	....
France	....	....	....	....
Czecho-Slovakia	....	....	....	....
Java	89,508	29,361	216,103	82,641
Philippine Islands	....	....	....	....
Cuba	....	50,465	258,907	408,557
Dutch Guiana	....	....	...	....
Hayti and San Domingo	11	2,831	35,981	98,112
Mexico	....	....	....	....
Peru	5,255	4,073	70,155	59,408
Brazil	2	....	77,148	22,332
Mauritius	....	110	130,976	93,584
British India	....	....	....	....
Straits Settlements	....	...	....	....
British West Indies, British Guiana & British Honduras	20	406	84,837	53,226
Other Countries	7,392	8,791	55,421	98,141
Total Raw Sugars	**102,189**	**97,685**	**935,457**	**941,075**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	1,183	1,919	42,725	98,785
Belgium	151	846	10,602	21,400
France	....	816	235	1,233
Czecho-Slovakia	83	154	70,905	150,274
Java	....	....	....	....
United States of America	791	11,774	95,661	57,126
Canada	550	1,234	28,328	25,760
Other Countries	1,445	951	30,633	43,407
Total Refined Sugars	**4,203**	**17,693**	**279,088**	**397,983**
Molasses	8,512	219	100,573	139,431
Total Imports	**114,904**	**115,597**	**1,315,118**	**1,478,489**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	48	3,054	635	5,744
Netherlands	270	128	1,217	598
Irish Free State	5,233	6,962	24,964	38,485
Channel Islands	115	90	749	814
Canada	....	...	....	...
Other Countries	811	2,738	4,995	9,906
	6,477	12,972	32,560	55,548
Foreign & Colonial Sugars.				
Refined and Candy	3,173	164	6,367	4,657
Unrefined	3,500	2,113	13,896	7,926
Various Mixed in Bond	....	....	....	.. .
Molasses	291	20	2,456	2,581
Total Exports	**13,441**	**15,269**	**55,279**	**70,712**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to October 1st	2,582,994	..	2,377,142
Deliveries „ „	2,576,658	..	2,371,810
Meltings by Refiners „ „	2,517,710	..	2,271,490
Exports of Refined „ „	185,000	..	195,000
Importers' Stocks, October 1st	7,130	..	5,332
Total Stocks, October 1st	71,317	..	103,101
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.		1922-23. Tons		1923-24 Tons.
Exports	3,235,393	..	2,909,624	..	3,203,592
Stocks	453,070	..	429,588	..	432,123
	3,688,463		3,339,212		3,635,715
Local Consumption	100,000	..	88,000	..	85,000
Receipts at Ports to August 31st	3,788,463		3,427,212		3,720,715

Havana, August 31st, 1924 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1922, 1923, AND 1924.

IMPORTS.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined......	392,333	..	279,088	..	397,983
Raw	1,061,962	.	935,457	..	941,075
Molasses ..	80,423	..	100,573	..	139,431
	1,534,718		1,315,118		1,478,489

EXPORTS (Foreign).

	1922. Tons.		1923. Tons.		1924. Tons.
Refined...... ..	3,272	..	6,367	..	4,657
Raw....	7,892	..	13,896	..	7,926
Molasses	2,500	..	2,456	..	2,581
	13,664		22,719		15,164

HOME CONSUMPTION.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined	371,710	.	292,480	..	396,442
Refined (in Bond) in the United Kingdom	714,241	..	708,426	..	699,523
Raw	122,169	.	119,082	..	101,499
Total of Sugar	1,208,120		1,119,988		1,197,464
Molasses	6,574	..	7,169	.	5,384
Molasses, manufactured (in Bond) in United Kingdom ..	38,317	..	39,449	..	44,291
	1,253,011		1,166,606		1,247,139

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1924.

	1922. Tons.		1923. Tons.		1924. Tons.
Refined in Bond	51,550	..	48,450	..	38,950
Foreign Refined	27,250	..	17,800	..	16,500
„ Unrefined..	185,600	..	183,600	..	89,250
	264,400		249,850		144,700

United Kingdom Monthly Sugar Report.

Our last report was dated the 5th September, 1924.

The market has been easier, and as we have been approaching the new European crops premiums have run off for near sugar. Generally prices all along the line are about 2s. per cwt. lower than a month ago.

The terminal market has been easier throughout the period under review, and although there have been one or two minor reactions quotations have been marked down. Holders of actual sugar finding it impossible to realise in the trade have sold heavily on the terminal market as a hedge. September was finally liquidated at 23s. 9d., and about 2000 tons of sugar was tendered on this delivery. October sold down from 23s. 7½d. to 21s. 10½d., November/December from 22s. to 20s. The fall in forward months has not been so severe, but a considerable business was done in March at 20s. 10½d. down to 19s. 7½d., and May 21s. to 19s. 9d. August has also been dealt in from 21s. 3d. to 20s. The latest prices are as follows: October 21s. 9d., November/December 20s., March 19s. 9d., May 19s. 10½d. and August 20s.

Trading in actual sugars has been very dull and each fresh transaction has taken place at a lower level. The trade anticipating larger supplies during November/December only bought sparingly on a strictly hand to mouth basis, and in consequence holders have been anxious to secure whatever premium remained. The export business continued right up to the end of September, and also during the first few days of October; but during the past week it has ceased entirely. It is interesting to note that the majority of these exports have gone to Germany, which country has been an anxious buyer of near at hand sugars. This rather points to the fact that the visible supplies in Germany to-day—as given by Mr. F. O. LICHT—are more imaginary than real.

Fine Granulated on the spot has fallen from 38s. 6d. to 35s. 9d.; White Javas from 36s. 6d. to 24s. 6d. Continental Granulated for prompt shipment has been exceedingly scarce but isolated lots of Dutch have been sold from 26s. to 23s. 6d. f.o.b. Holland. American Granulated, second-hand, fell from 26s. to 24s. 6d. c.i.f., but the first-hand prices are well above this parity. White Javas sold from 23s. 6d. to 22s. 3d. c.i.f. Slightly more interest has been shown in October and November/December Granulated; Czecho Granulated for October sold from 23s. 9d. to 22s. 3d.; first half November from 22s. to 21s; November from 21s. 6d. to 20s. 9d.; and December from 21s. to 20s. 6d. Dutch Granulated for November sold from 22s. to 20s. 9d., and December at 21s. 6d. to 20s. 6d. Belgian Crystals have been on offer for November/December from 21s. 6d. to 20s. 3d. German Granulated for new crop has not been offered.

The British Refiners have also suffered from the general depression of the trade, and have been forced to reduce their prices. On September 18th Cubes were reduced 1s. per cwt., and Granulated 6d. per cwt.; on October 1st all prices were quoted 1s. 6d. per cwt. lower; again on October 7th Cubes were marked down 1s. 6d., and Granulated 1s., making a total reduction on Cubes 4s. per cwt. and Granulated 3s. The latest quotations are No. 1 Cubes 41s. 6d., and London Granulated 37s. 9d.

Business in raws has been quiet, and the Refiners have only bought sparingly, transactions having taken place in limited quantities of Mozambiques and Perus at prices varying from 21s. to 18s. 9d. c.i.f. A fair business has been done in 88 per cent. Beet for October from 19s. to 18s. 6d. c.i.f., November from 18s. 6d. to 17s. 3d. c.i.f., and December down to 16s. 9d. c.i.f.

The demand for Refined in America has also been poor compared to the previous month, but in spite of this raw Cubans have been maintained on a 4 cents basis.

Mr. F. O. LICHT has issued his preliminary estimate of the European Beet crops, as follows:—

	TONS.		TONS.
Germany	1,475,000	Spain	250,000
Czecho-Slovakia	1,450,000	Hungary	180,000
France..	750,000	Sweden..	160,000
Poland	480,000	Denmark	155,000
Russia	390,000	Austria..	60,000
Italy..	380,000	Other countries	310,000
Belgium	350,000		
Holland	310,000	Total	6,700,000

It is, however, thought by other competent authorities that this estimate is about 200,000 tons too high.

The U.K. Board of Trade figures just issued give the September consumption as 126,000 tons, and the total stock in the U.K. on the 1st October as 145,000 tons.

21, Mincing Lane,
London, E.C. 3.
October 10th, 1924.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 311. NOVEMBER, 1924. Vol. XXVI.

Notes and Comments.

The Return to Stable Government.

The Labour Government's ill-advised decision to dissolve Parliament and appeal to the electors because the Conservative and Liberal Opposition resented their political interference with the course of Justice in a trial for sedition, and also objected to their dealings with the Russian Communists, has brought them no benefit. It was quite on the cards that the result of the elections would make the Conservative party stronger if not that of Labour weaker ; but there were few who were prepared to prophesy with a certain voice that the Conservatives would get a clear majority over all the rest combined. It was something to hope for ; but the most optimistic supporter of the party never dreamt of actually achieving a majority of over 200 at the polls. Yet this is what has happened. In spite of the elections being rushed within the short space of three weeks, which left little time to stir up the voters, the latter nevertheless were thoroughly aroused to the danger which threatened the constitution of their country owing to the extreme socialist and communistic tendencies of those who were proving the power behind the Labour Government. The disclosure during the last week of a secret letter from a notorious Communist leader in Russia counselling the stirring up of sedition in this country (a letter known to the Cabinet but kept back by them till its reproduction in a leading daily paper forced them to admit it and disown it) proved the last straw in deciding the electors to sweep the Government out of power and replace it by a more constitutional and stable party. In the struggle Liberalism was nearly wiped out ; thousands of Liberals evidently voted for the Conservatives as being the only party likely to secure a clear majority, while other thousands did the same because they resented the part Liberalism had played last January in putting Labour into office. In addition, of the two million extra voters (10 per cent. of the electorate) who voted for the winning party, a very large number belonged to the class which as a rule does not trouble to vote at all but this time registered its opinion as a protest against the attempts to undermine the constitution with Bolshevism.

The net result has been that whereas the Conservatives in the last Parliament numbered 258 (and in the preceding one when Mr. BALDWIN went to the country on a tariff reform ticket, 346), they now total 413: a net gain of 155 seats.[1] Labour numbered 193 in the old house (144 in 1923) but comes back now reduced to 150. Liberalism has suffered an eclipse quite disproportionate to the total votes cast for it. Last time it numbered 158 adherents; now it has no more than 39, and it has lost at the poll Mr. ASQUITH, its leader, and several other front bench men. Hence there are no longer three big parties in the House, any two of them able to outvote the third. The Conservatives have the huge majority over all other parties of 211 in a House of 615 members, and have a clear field before them for the space of four or five years. Mr. Baldwin's luck has admittedly been wonderful; he threw away a safe majority a year ago in an honest attempt to get the country's permission to introduce tariffs and preferences; and it looked as though he had lost his chance of himself steering the country past the dangers of the upheaval caused by the war and its aftermath. Yet after the short interval of nine months he is returned to power with a majority practically three times that which he threw away in the autumn election of 1923.

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[1] At time of writing, three results (Scottish University seats) are unannounced. Our figures assume these will yield no change.

The new Government has a great opportunity before it, such as is seldom given to any political party. It has got to justify the huge trust bestowed on it and use its majority wisely for the good of the whole country and not merely for selfish party ends. If it does not, then the swing of the pendulum will come sooner or later, and as it has swung so far to one side now, it may swing widely to the other side next time, if the party of law and order does not serve the country's best interests. This is admitted on all sides; the dangers which accompany a too big majority are patent to most observers. We can only express the hope that Mr. BALDWIN and his new Government will work resolutely and disinterestedly for the welfare and prosperity of the nation and the alleviation of the unemployment and suffering which is so widespread. They will have no easy task, and will doubtless meet with some organized attempt at "passive resistance" but they have ample time before them, wherein to carry out their settled policy and prove its utility.

Sugar under the Conservative Rule.

The chief interest for us in the new Government policy will lie in the manner it tackles the sugar question—the development of home-grown beet sugar, and the extension of sugar production in our Colonies. Towards both projects the Conservatives are known to be favourably disposed. We said last month that Mr. BALDWIN if returned to power would be likely to carry out Mr. Snowden's plans for aiding home-grown beet; only a few days later he enunciated broadly his agricultural policy, in the course of which he specially mentioned the beet sugar industry as one he would foster if he came into office again. It may therefore be taken for granted that whether Mr. Snowden's precise method of aiding this industry is legalized or not, the latter may count itself safe from any setback of support, and capital can rest assured that the new party in power will not be less concerned to make the venture a success than was the recently converted Labour party.

Then there is the question of Imperial Preference. Mr. BALDWIN has given a firm electoral promise not to introduce any general tariffs or food taxes, but he has also intimated that Imperial Preference generally will be an object to be extended. How far he will be able to carry out this policy without clashing with his promises remains to be seen. As regards sugar at any rate the way is clear, inasmuch as there is still a duty on sugar which can be differentiated to allow preferences. Last Budget the sugar duty was cut down from 25s. 8d. to 11s. 8d. which made the preferential duty on Empire sugar one of 9s. 9d. There is no reason whatever why this duty should not be totally removed in the case of

Empire sugar, in which event the latter would have an advantage over foreign sugar of 11s. 8d. per cwt. or say 1¼d. per lb.

If this were done, then the excise duty of 9s. 9d. on home beet would also have to come off, and since beet sugar is counting on a total advantage over foreign sugar of 21s. 8d., the balance of 9s. 9d. would doubtless have to be made up by means of a subsidy. This would, it is true, reduce the advantage of home-grown beet over Imperial cane from 19s. 6d. to 9s. 9d. or by half. But the imports of Imperial sugar into this country are still so small a part of the total imports of sugar that the effect on the home industry of such a reduction would be comparatively small for a long while to come. Foreign beet and cane are what the home beet industry has to contend with and from them it needs protecting. Empire sugar is no real competitor at present and cannot be for many years, so the difference indicated of 9s. 9d. should assuredly be sufficient to allow the less developed home beet industry to overcome its initial difficulties. This argument of course assumes that the new Conservative Government will decide that the sugar duty as reduced last summer is to remain so reduced; to increase it again would only give the Labour party a convenient excuse for declaring that the new régime meant increased taxation of food. What Empire sugar wants is security for years to come, and a steady preference will ensure this, even if the amount of the preference be less than some enthusiasts would ask for.

Some Members of the New Cabinet.

As we go to press, we learn of the appointments to Mr. Baldwin's new Government. The outstanding surprise feature is the election of Mr. WINSTON CHURCHILL as the new Chancellor of the Exchequer. He has not previously held any post at the Treasury, but is a man of great energy and consummate ability, and it may well prove the case that he will make his mark in his new post. He is a Free Trader, but not a doctrinaire one, and his election speeches have revealed a sympathy towards Imperial Preference and home industry that should be in harmony with Mr. Baldwin's broad ideals. On the other hand, his appointment is some assurance, if it were indeed needed, that no general taxation of imports or of imported food will be encouraged. The Colonial Office goes to Mr. AMERY who has already served as Parliamentary Secretary for the Colonies, and is known to be in full sympathy with the desires of our overseas dominions and territories. Another man, who has had experience of the sugar planter's lot, is the Attorney-General, Sir DOUGLAS HOGG (son of the late QUENTIN HOGG), and as he has a seat in the Cabinet his practical experience will be available when our Imperial sugar policy is under discussion. Mr. EDWARD WOOD, who recently toured the West Indies, is also in the Cabinet as Minister of Agriculture and Fisheries. These appointments, to mention a very few, are some good augury of the question of the sugar supply of this country receiving in the near future reasoned investigation and direction.

Empire Preference a Safeguard against Monopoly.

Recently the *Times Trade Supplement* had a pertinent article on the value of Imperial Preference as a means of combating the danger of an American monopoly of the supply of sugar. It remarked that the attitude of the then Government as revealed in its Budget had arrested the development of sugar schemes in the Empire and had thus given impetus to the American movement for the control of the world's supply. It is well known, the writer declared, that behind a formidable shield of protection the great American sugar *entente* has come to dominate the cane sugar world; and the latest instance of its activity is the arranging of a credit of four million dollars for the German beet sugar industry under the ægis of a group of American bankers. The result of this will tend to put the American group in complete command of the situation, because if in addition to their present control of nearly all the production in the United States, Hawaii, the Philippines, and Cuba, they direct the policy of the German sugar producers—rapidly approaching a strong export position—they will be able to dictate the sugar price of the world; particularly if terms can be arranged with Czecho-Slovakia, an arrangement which would render their domination overwhelming. From the evil effects to the consumer of such domination Great Britain can only escape by being able to produce within the Empire a large proportion of the sugar she needs.

This is all too plain, and one must look to the new Baldwin administration to give a firm and lasting fillip to the Empire movement, just as the last Government did to the home beet sugar one (though only, be it observed, because the Conservative party were already committed to the idea and could be counted on to support the necessary measures).

And while on this subject it may be asked why the English refiners instead of complaining in public and in Parliament at the alleged injustice to their industry of the incidence of the new subsidy to an infant home beet industry, do not draw more attention to the danger from their foreign rivals, the American refiners, who are beginning to use England as a dumping ground for their surplus output? Why do they not also take steps themselves to produce raw sugar in the colonies for their refineries and so ensure a steady supply—a plan which the American refiners on their part have carried out in Cuba? Is it that they count ere many years are run on getting ample supplies of 88 per cent. beet from the Continent as before the war? But what if the Continent gradually turns to making white sugar so that its available surplus will not be raws but "crystal sugar"? These are some questions on which one would like some enlightenment: when the problem of extending the Empire supply of sugar comes before Parliament (as it is sure to do before many months are gone) the refiners have it in their power to make a useful contribution to the subject.

British Beet from British Machinery.

The British Empire Sugar Machinery Manufacturers Association (sometimes termed the "Besma" for short) addressed last month a letter to all candidates for Parliament in the recent elections in which they said: "Quite recently the Labour Government granted a subsidy to the British beet sugar industry, but omitted to make a stipulation that any factory built to take advantage of this subsidy should be built and equipped by British labour. Bearing in mind the state of unemployment, this was a serious omission; and it is now reported that the whole of the machinery for one of the first factories to be built is going to be ordered from the Continent, British tenders not even being asked for. This is not a satisfactory state of affairs, as there are British firms with the necessary experience and equipment for doing this work. The members of the new Parliament about to be elected should see that steps are taken to prevent the large amount of work thus involved being sent out of the country."

If it be true that British tenders are not even asked for, then the B.E.S.M.A. have a legitimate cause for grievance, since even if foreign advice is called in with regard to the design and arrangement of a new beet factory in this country, the actual construction of the machinery and apparatus should, if cost estimates allow, be given to home manufacturers rather than to foreign firms. But we were under the impression that the Anglo-Scottish Beet Sugar Corporation, which is a private limited company, had amongst its directorate members of a firm of sugar machinery manufacturers in Glasgow, and that at least one projected factory in the Eastern counties is promoted by a group which includes another Glasgow machinery firm. If this be so, then we cannot suppose that either of the two firms concerned would willingly allow contracts to go abroad that could equally well be executed in this country. As for the factories schemed by the Anglo-Dutch group, the same inducement does not equally apply, and it may well be that this group is showing a not unnatural preference for Continental machinery, with which its sponsors are more familiar. The decision whether or not to interfere with these inclinations must rest with the Government who in granting a subsidy to the industry may if they think fit make certain stipulations in the interests of the home engineering trade which is still in a bad way and has a good deal of unemployment to record. The subsidy to the industry is not yet authorized by Parliament, so the B.E.S.M.A.'s appeal to electoral candidates may not be without result.

Progress of the Beet Sugar Industry in England.

Further information is now available with regard to the Ely beet sugar scheme, one of the six new factories referred to by Mr. SNOWDEN on July 30th in the House of Commons. The Ely Beet Sugar Factory, Ltd., was registered as a public company on October 20th last with a nominal capital of £300,000 in £1 shares, to enter into two agreements (1) with the Centrale Suikermaatschappij and (2) with Sir F. HIAM, J. P. VAN ROSSUM, Dr. ABRAHAM WIJNBERG, and Dr. J. A. VAN LOON, to cultivate and deal in sugar beet and its products. This is the first of the new factories projected by the Anglo-Dutch group. The directors to operate the scheme will be Sir JAMES MARTIN, of Messrs. Martin, Farlow & Company, Incorporated Accountants; Sir FREDERICK HIAM, a leading Cambridgeshire farmer; Col. G. L. COURTHOPE, M.C., M.P., Chairman of the Central Landowners Association; and the three well-known Dutch beet sugar experts above referred to. The Rt. Hon. GEO. H. ROBERTS will act as alternate Director to Mr. VAN ROSSUM, and Mr. ALFRED WOOD will be the Secretary. No notice of the situation of the registered office, however, was filed at the time of the incorporation. The site of the factory is at Ely on the L. & N. E. Railway and the River Ouse, and has been acquired from the Ecclesiastical Commissioners. The architects and consulting engineers are Messrs. Hal Williams & Co., of London. Work on the site has already been commenced and the factory will be ready for the manufacturing season of 1925.

International Commission for Methods of Sugar Analysis.

Last month it was stated in this Journal in regard to the International Commission for Sugar Analysis,[1] that British, French, Belgian, and apparently also American and Czecho-Slovakian chemists, much as they respect the scientific eminence of Prof. HERZFELD, the permanent President, find themselves unable to take part in a meeting under his Chairmanship. Prof. HERZFELD now writes to say that the statement that he refuses to resign his presidency is not correct. But in recording Prof. HERZFELD's assurance on this point, it may be remarked all the same that he has not yet resigned his position as permanent president of the Conference, which owing to international dissension, has not met since 1912. It is much to be hoped that in the near future all the representatives of the nationalities concerned once more will agree to meet, either in Europe or America, this time under a new presidency, so that questions, the settlement of which has now become very desirable, may at last be discussed.

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[1] *I.S.J.*, 1924, 517.

The Natal Sugar Congress of April, 1924.

The proceedings of this Congress, as printed in the *South African Sugar Journal*, show that the industry, after a somewhat lengthy period of complacency, is becoming very much exercised as to its future. The subjects discussed, as in last year's meeting,[1] covered a wide field, and it is worthy of note that, in certain matters, the year has clarified the view and brought a considerable amount of unanimity in what appeared to be very debatable questions then. This was perhaps especially seen with regard to the methods of dealing with the mosaic disease and the founding of the experiment station. Substantial agreement has been reached, and these matters have gone forward to such an extent that very little time was devoted during the Congress week to their consideration. The experiment station may be said to have been started, since its first Director had been appointed, and actually arrived in Natal during the week; there was practical agreement that it was necessary to destroy all varieties susceptible to mosaic at present growing in Natal; and the greenhouse to be used for the introduction of approved varieties into a mosaic-free country had been designed and placed on order.

As suggested in our note last year, there is an enormous amount of work awaiting the attention of the industry, and the papers read show a widening range, and tentatively explore new directions of activity. In next year's Congress (for we assume that it will now become an annual meeting), it is likely that a considerable amount of floor space will be given to the newly appointed Director of the station, when he has had some time to accustom himself to the local conditions of soil and climate and the planters' difficulties, and we shall await his pronouncements with great interest. Meantime, the papers read covered a considerable portion of the plantation work. Besides various factory matters, including the milling difficulties of the Uba cane and its deterioration after cutting, and the importance of introducing labour-saving methods in the mill yard, simple lectures were delivered on the properties of soil, soil fertility, the growth of plants, and various diseases and pests of the sugar cane. A short paper was read on cultivation and weeding in heavy black soils, and the whole question of manuring received a somewhat more detailed treatment. The question of labour occupied a somewhat prominent place, interesting papers having been read by three Union officials with wide experience on the native question, especially as to the position of the sugar industry. This is of course the basal factor in sugar production and, after reading these papers and the discussion which followed, the general outside opinion that Natal is blessed with abundant cheap labour will have to be somewhat modified. Little appears to have been hitherto done in introducing labour-saving devices in the fields, and the whole question of transport received special attention in another paper. The principles and practice of plantation costings and the value of agricultural statistics were expounded ; and there appeared to be a general concensus of opinion that it is desirable that the whole industry should be overhauled and stabilized at the earliest possible moment.

A useful summary of the rainfall on the coastal belt is printed, and in a well illustrated supplement details are given of the history and equipment of certain of the larger concerns. But all this by no means exhausts this compendium on the Natal Sugar Industry, and the whole Congress number, extending to some 200 pages, reflects great credit on the *South African Sugar Journal*, for placing together such a mass of information in so handy and readable a form.

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[1] *I S.J.*, 1923, pp. 568-571.

Notes and Comments.

Alcohol from Molasses in Cuba.

According to a correspondent in the *Cuba Review*, there is an astonishing demand in the United States for raw molasses from Cuba, where not long ago this by-product used to be dumped into the sea to get rid of it. Less than a decade ago molasses fetched only about 1½ cents per gallon, while recent quotations have been as high as 9 cents. And it is said that a representative of one of the big distilling houses in the United States has offered a syndicate of 14 Cuban factories to purchase all the molasses they could produce in the next two years, the sellers to make their own price. The opinion has indeed been expressed that if the output of molasses in Cuba were quadrupled, it would not satisfy the demand in the United States. One distilling plant in Baltimore alone consumes 175,000 gallons per day in the manufacture of denatured alcohol.

The explanation of this abnormal demand is not, it seems, wholly accounted for by the increase in the demand for industrial alcohol. We are told by the above mentioned writer that of the 30 odd formula furnished by the U.S. Government for rendering alcohol unfit for drinking purposes, several at least can be neutralized sufficiently to let the alcohol serve as a beverage of sorts to be added to the bootleggers' stocks. That this type of alcohol is a slow poison and brings on arterio-sclerosis or else diabetes apparently does not weigh with the parties who produce and retail it. This is one of the evils which is a consequence of the prohibition laws.

However one effect on Cuba of this commandeering of all available molasses is to place the manufacturers of commercial alcohol in Cuba in a rather difficult position, as they have to pay so much for their raw product that the price of the alcohol has advanced to 30 cents per gallon. It is true that these distilleries are of limited capacity and very poorly equipped, since much of the machinery is adapted plant imported from the States. But they also suffer from lack of a local source of sulphuric ether without which the alcohol is no substitute for gasoline as a motive power.

It is indeed unfortunate that Cuba with its large supply of molasses should be without at least one up-to-date plant for the manufacture of high grade motor spirit, to supply the fuel for a big extension of motor cars and trucks in the island. It is stated that with modern machinery and with the abundance of molasses always to hand in Cuba, a motor spirit infinitely superior to gasoline could be manufactured and sold in Havana at 25 cents per gallon and still leave a fair margin of profit. But if the molasses is to be cheap, an export tax on that commodity appears inevitable.

The Expansion of the Czecho-Slovakian Beet Sugar Industry.

Tables reproduced by the Department of Overseas Trade from the Czecho-Slovakian Sugar Association *Bulletin* shows clearly the steady expansion of the sugar industry in that country. In 1888-89 the sugar production amounted to 448,500 metric tons ; in 1910-11 to 1,098,200 tons ; in 1912-13 to 1,474,000 tons ; in 1920-21 to 717,100 tons ; and for 1924-25 the estimate is 1,230,700 metric tons. The number of factories has steadily declined, being for the years mentioned 194, 172, 173, 173, and 158 respectively. This latter fact shows that since the war there has been a marked movement to amalgamate previous small establishments or replace them with much larger modern factories. As for the production, the present campaign of over 1,200,000 tons shows progressive leaps from that of the years 1920-21 to 1923-24 and again to 1924-25, so a reasonable optimism as to future production may well be entertained. At the same time it should not be forgotten for purposes of comparison that although the pre-war level of 1912-13 has not yet been reached, the 1913-14 production of 1,268,686 metric tons is practically attained. This means that Czecho-Slovakia has managed to bring this industry back to normal despite the economic effects and after-effects of the war.

Fifty Years Ago.

From the "Sugar Cane," November, 1874.

Mr. WILSON FORSTER was now editing the *Sugar Cane*, and in a leading article, in which he strongly urged a more progressive attitude among cane sugar producers in their competition against beet sugar, " a striking contrast to these crude productions from the cane," he made the following remarks:—

"We are apt to lose sight of the advance which is made beyond us when we do not practically come into contact with our rivals. We put up with old and bad methods of manufacture, when a knowledge of better ones would convince us of the necessity of improvement; and to no industry are these remarks more applicable than they are to cane sugar planters in many parts of the world. One of the chief objects of the *Sugar Cane* is to enable planters to profit by such knowledge and by a closer intercourse with each other; but this can only be effected by their co-operation with the Editor; and the ablest planters, by making the columns of the *Sugar Cane* a medium for the enlightenment of their co-workers in other parts of the world, will themselves be served even more than they serve by the practical assistance they will afford in making the magazine worthy of representing the important and interesting industry in which they are engaged, and capable of effecting the service which we have indicated. . . . . ."

In another article entitled " Central Factories," by a correspondent writing from Jamaica, appeared some statements reflecting the position of the art of cane sugar manufacture fifty years ago. Some of these are here reprinted from our predecessor:

" We are more and more convinced that the use of animal charcoal ought to be avoided in the tropics, wherever it is possible. With charcoal there is of course much sweet water (char washings) to be concentrated; this, together with the reburning of the char, consumes much fuel. Its use adds considerably to the cost of the plant; it needs attention, which is rarely to be had, and is in other respects objectionable . . . . . Where the triple effect is employed, there is of course no choice, charcoal must be used, because without it the tubes of the apparatus would become clogged up with lime salts, very much more rapidly than even at present. Where, however, the Concretor is used for concentrating, the necessity for the use of char disappears. Syrup prepared by the Concretor is brighter and better than from the triple effect, and the Concretor furnace is far better suited for burning wet megass as it comes from the mill than the locomotive furnaces in which a portion of this material, together with coal, is burnt in the French central factories. . . . . . You will see, therefore, that we have no hesitation in confirming your views as to the superiority of the Concretor to the triple effect for reducing the juice to syrup. . . . . . There is no doubt that a well-designed and well-managed central factory will give very much better results than can be obtained at the ordinary muscovado process, but the margin is not so great between the results which are to be expected from it and those obtainable by a planter making concrete. . . . . ."

The official organ of the National Cane Growers' Association, *La Industria Azucarera*, has published the totals of cane and cane sugar produced in Argentina during the crop year, May 1st, 1923, to April 30th, 1924. During the season 3,755,840 metric tons of cane were ground, producing 257,419 metric tons of sugar. Of the total sugar production, 201,633 metric tons were produced in the Province of Tucuman, the principal sugar producing section of Argentina.

The Agricultural Position in Natal.[1]

A summary of the subjects dealt with, on the agricultural side, at the Natal Sugar Congress, of April, 1924, appears in our Notes and Comments. It is proposed to give some idea of their contents and to extract what may be interesting to our readers in the present paper. Taking the subjects in their natural order, C. O. WILLIAMS, in his lecture on the properties of soil, gives a clear and simple statement of this rather intricate technical subject. Chemical analyses of soil have of course considerable value, but cannot be used as sole guides to correct manurial treatment, and the author devotes his attention chiefly to another highly important factor, namely the physical condition, and the way in which water and air exist in the soil. These are the substances of most importance to the roots, in enabling them to extract the mineral substances which the plant requires. The water is present as a delicate film round each ultimate particle of soil, and the air takes up the remainder of the intervening space; the aim of cultivation is to a great extent connected with the regulation of these spaces, increasing them in heavy, close grained clays, and diminishing them in soils of more open, sandy nature. The space may be enlarged in clayey soils by various methods of "flocculation" by which the minute particles are grouped together into small complexes, and diminished in sandy soils by the introduction of vegetable matter. The author considers green manuring to be of more importance in sandy than in clayey soils for this reason. The films of water of adjoining particles being in intimate connexion with one another, movement is constantly taking place by the flow of water from places where thick films occur to those where the film is thin. This is specially seen in the upward creeping movement from the deep water region to the surface which constantly loses its water by the plant's demands and by evaporation. But this flow of film water cannot take place unless the soil particles are undisturbed; it is rendered difficult in the topmost layers by cultivation which breaks up the water currents, and hence the value of light surface cultivation in preventing evaporation in such a dry country as Natal, when growing such a large water consumer as the sugar cane.

Soil fertility is the subject of another short lecture, from which we only abstract certain interesting and convenient figures. A sandy sugar cane soil will have 0·06 per cent. of nitrogen, 0·04 per cent. of potash, 0·01 of phosphoric acid and 0·05 of lime. This means that, in the 2½ million pounds of soil in the first nine inches of an acre of land, there will be 1500 lbs. of nitrogen, 1000 of potash, 250 of phosphoric acid and 1250 of lime. A 25-ton crop of cane extracts more or less 85 lbs. of nitrogen, 54 of potash, 37 of phosphoric acid and 44 of lime; therefore, if all the food contained in the soil were available for the cane plants, there would be enough nitrogen for 17 years, potash for 18·5, phosphorus for 6·7 and lime for 28·4. Such a deduction is however extremely erroneous, because of the presence of other factors which enter into the question of soil fertility, again leading to the conclusion that mere chemical analysis may land us into a false position regarding the capability of any soil to produce crops. Similarly, we extract certain figures from the simple botanical lecture on plant growth. Here it is stated that a 40-ton crop of canes, besides taking from the soil its mineral food proportionately to the figures given above, requires 229,504 cub. ft. of carbonic acid gas, which is present in very small quantities in the air, to build up its carbonaceous skeleton and sugary contents. The same crop will require roughly 4800 tons of water from the soil; and, as one inch of rain is approximately equal to 100 tons to the acre, a rainfall of 48 inches would satisfy the needs of a 40-ton crop, if it at all got to the plant—which is unfortunately by no means the case. In the discussion on these three papers various facts were elicited. It is stated that a clay soil does not need green manuring nearly so much as a sandy one, and the main needs of the former class of soil are cultivation and drainage. Also, a rich soil needs considerably less water for the same crop than when produced by a poor soil, presumably because of the greater amount of food contained in solution in it. One way then of fighting the prevailing lack of water in Natal would be not only to conserve the water in the soil by all possible means, but to add to its richness in food materials by every method which is feasible. *Inter alia*, one planter gives the following practice which he has found to be highly successful; he places the manure with the seed cane and covers it over, then after a few days sprinkles a little lime over the surface and leaves it there. Lastly, with the exception of cow peas, lucerne and native leguminous weeds, the root nodules which are such an important factor in providing the soil with nitrogen are never fully developed in the canefields of Natal, a matter to be borne in mind when selecting the variety for use as a green manuring crop. The introduction of small quantities of soil with the seed from countries where the nodules are freely developed would go far to remedy this evil, but it would be a matter of time even then.

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[1] *South African Sugar Journal*, Congress and Exhibition Number, June, 1924. A reference to the papers read at the Congress of 1923 is given in *I.S.J.*, 1923, pp. 569–571.

As regards pests and diseases, H. H. STOREY summarizes in a few lines the present position of the mosaic question, and adds a short non-technical description of the new streak disease of the Uba cane for general information. The latter paper is summarized elsewhere in this number of the Journal. It is gratifying to learn that considerable progress had been made at the time of reading the paper in regard to the eradication of all susceptible cane varieties in Natal, that is, all varieties excepting Uba itself. The general principle of such action was accepted, although this desirable result was not reached without some very hard work on STOREY's part. The opinions of two recognized authorities, E. W. BRANDES in the United States and F. S. EARLE in Porto Rico, were invited, and both wholeheartedly supported the propositions laid before last year's meeting of the Congress. Ways and means had been carefully considered, but complete agreement had not been reached concerning the fate of certain isolated plots of Agaul, apparently a close relative of Uba but, unlike it, subject to mosaic. The main line during the year was to locate the scattered small plots of soft, susceptible varieties grown by the Indians and natives for chewing purposes. Already nearly 500 such plots had been marked down, and it was hoped that soon a complete survey would be finished, two inspectors having been added to the investigating staff for the purpose. The necessary proclamation had been drafted, and the proposed destruction of these plots as well as those under European management should have been arranged for by now. There appeared to be a growing feeling, certainly aided by the discovery that the Uba cane itself was suffering from a wide-spread disease of a similar nature, that the industry could not safely trust its future to the Uba variety alone; and plans were rapidly approaching completion for the introduction under rigid precautions of such new kinds of cane as were likely to be useful as second strings to Uba, or if necessary to replace that cane altogether. This piece of work cannot, however, be completed for some considerable period, making it all the more necessary that it should be commenced at the earliest possible moment. It was agreed that until the mosaic disease was completely stamped out of Natal no such introductions should take place. Meantime plans were completed for the erection of an insect proof greenhouse, in such a position as to be readily (even daily) inspected by the Mycologist and Entomologist, who were working in close collaboration, in which the newly introduced cane varieties could be grown on for the necessary period of quarantine (two years ?), before being passed on to the Experiment Station for testing and finally multiplying before distribution to the planters. The progress, in short, has been so rapid during the year's interval, that it appears probable that a complete agreement may have been reached already, and the active campaign of eradication commenced.

The methods of quarantine considered necessary were detailed in another paper of STOREY's read at the Congress. Into these we need not go, as they are similar to those laid down by NORTH in Australia as described in the last number of the Journal.[1] However desirable it may be that the greenhouse should be placed at some spot outside the actual sugar cane zone in Natal, this desideratum has been regarded as less important than the constant inspection of the canes throughout their growth. And in this respect NORTH's proposals have the advantage, in that his head office is in Sydney far to the south of the cane growing country. The whole of the details offered to the members of the Congress on this subject, finally, throw a clear light on the immense amount of work which had been done during the year, not only in working out plans for the future, but in propaganda work among the planters who took part in the discussion.

It is not, of course, possible to enter into the details of all the papers read before the Congress, dealing with plantation work; and we must leave for the present the interesting account of the Mystery Army Worm given by C. P. VAN DER MERWE, the Government Entomologist, and turn to the other outstanding question of the hour, that of plantation labour. It is especially needful that the industry should have a clear view of this problem, because, in case the Uba cane has to give way to others of a better character, it will inevitably mean better cultivation all round. Three papers on this subject were read by Union officials definitely associated with the native problem, and the Congress is to be congratulated on the presence of these gentlemen and the sympathetic attitude which they displayed to the planters in their local difficulties. Of these papers the longest and most detailed was that of Dr. G. A. PARK-ROSS, and it must be confessed that it was a remarkably straight talk, chiefly from the medical and economic points of view. Although it is obvious from the discussion that followed the reading of these papers that there are many difficulties in the way of accepting the suggestions offered as a whole, the attitude of the planters was not at all unfavourable, and there is little doubt that a concerted effort will be made to improve the labour conditions now that the deficiencies have been brought home in so convincing a manner. The present position appears to be that, while certain progressive concerns have made considerable strides in the right direction, there is often much to be desired in the treatment of labourers on the sugar estates—quite sufficient, it was pointed out, to give the industry a bad name with the natives imported from certain distant areas.

Leaving the Indians out of account, who are reported to be leaving plantation work, there are two main sources from which the estate labourers are obtained, and these of entirely different classes and under very different conditions of life. In the first place there are the Zulus of the country and, in the second, natives of various tribes recruited from a distance. The Zulus come in from their kraals which are usually near at hand; they are of fine physique and if so inclined can do very good work. Their houses are located on fertile land where they enjoy considerable amenities; this being so, absences are frequent, whether for marriages, beer drinkings or even faction fights. They are less dependent on the plantations than the imported class. These often come from tracts of arid country, with the natural result that they are of poorer physical character, often suffering to a great extent from scurvy through insufficiency of vitamines in their food. They are often sick on arrival and require much care and cannot be given much heavy work or they will break down. But to let them leave because of the latter condition, as is sometimes done, is obviously the very way to give the plantation work a bad name with the tribe from which they come. With careful nursing they may turn out quite satisfactorily, but this throws a great burden on the planters, especially on the smaller concerns.

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[1] *I.S.J.*, 1924, pp, 522-528.

There is, however, another important factor which was clearly put by the various authorities, namely, the character of the demand for this very labour by other industries. There is in fact a very keen competition for imported labour in this part of South Africa, and unfortunately for the sugar planters they are pitted against corporations with a great deal of capital, namely the gold mines and the Natal coal mines. For mine work, strict medical examination is necessary, but there appears to be very little of this for work on the sugar estates, so that inevitably the least fit are likely to be sent. This class of labour is collected by special recruiting agents who visit the kraals, and it is stated that they not infrequently give an altogether wrong impression of the conditions of work and living on the plantations to induce the natives to go there And this also does not tend to make it easier for the sugar planters. The housing arrangements and the food provided by the mines are superior to those on the plantations, although the work in the fields is distinctly more to the liking of the natives. Presumably there is now a greater demand in the estates for imported labour than was formerly the case, and it may be that with stricter oversight of the "coolie catchers," an independent medical examination for at any rate reasonable fitness, and some improvement in food and housing conditions, a good deal may be done to improve matters; but it is made fairly clear that, unless something is quickly done in these directions, the industry is likely to be in an increasingly difficult position as regards labour, which may have a great deal of influence on the evident desire of stabilizing the plantations in the near future. Various suggestions were made by the readers of the papers, drawn from their wider experience, as to other possible sources of supply, into which we, however, cannot go. Improved food supplies are shown to be possible wlthout any great outlay, housing can only be gradually brought somewhat more in line with that of the mines labour; and almost more insistent is the demand for continuous medical supervision through a system of dressing stations for minor disorders and hospitals for severe cases, a problem which may well tax the limited resources of the planters almost beyond bounds. The local feeling among these entering into the discussion was not however so pessimistic as might be gathered from this outside view of the case; and it is evident that much can and will be done to place matters in a more favourable position as time goes on.

O. A. B.

C. W. SCHONEBAUM[1] has carried out experiments to determine whether when beets are frozen a loss of sugar occurs; but he found the sucrose content to remain constant when they were kept at 2° for three days, nor did it alter while thawing during 24 hours at 10° C.

[1] *Tijdschrift*, 1924, 308-309.

The Influence of Mosaic on Yield in Louisiana.

Of a series of articles which have appeared in a contemporary offering various explanations of the gradual decline observable in the cane field of Louisiana, we have selected for discussion one by E. W. Brandes,[1] because of the information contained in it about the mosaic disease. In this article the author quotes Stubbs, as blaming the last few unfavourable seasons and maintaining that there is nothing wrong with the fertility of the soil, but points out that this is no explanation of the gradual decline in yield which has been taking place through a series of years. Cross, on the other hand, he says, traces much of the decrease to mosaic, and questions the finding of the Committee of Agricultural Progress that it is due to a diminution of humus in the fields with a consequent decrease of fertility. The author considers that no one person is likely to be able to deal with all the factors; soil fertility is certainly involved, together with an accumulation of pests and diseases. There is no need to enter into the controversy which has arisen of soil *versus* mosaic, for each of the factors is capable of isolation, and should be separately tested in order to decide its relative importance. Already investigations have been commenced as to the influence of root rot and the deterioration of seed cane, both of which are considered to be more important than mosaic, which latter forms the subject of his communication.

A great mass of information on the subject of mosaic in Louisiana has been accumulated in the office of Sugar Plant Investigations. And from these planters can readily learn, concerning their tract, the date of the appearance of the disease, the percentage of infection, and the deleterious effect caused by it entirely independently of any other factors. The first authentic record of the presence of mosaic in Louisiana dates from 1919 when, immediately, a comprehensive survey was undertaken of the cane fields. The disease was then found to be widespread, but in very varying intensity. The Bayou la Tèche district was free, with the exception of a few rows of recently introduced varieties; Bayou la Fourche was only infected to the extent of 1-4 per cent., while the River district was already seriously involved, sometimes to the extent of 75 per cent. This survey was repeated in the following season, and altogether over one thousand records were obtained by the inspectors in charge of the work. On comparing the figures collected in these two surveys, considerable light is thrown on the rate of spread of the new disease in Louisiana. Thus in Tèche, which showed no mosaic in the plantations in 1919, only 81·77 per cent. was free in 1920; the free area declined in Fourche from 75 per cent. in 1919 to 12·42 in 1920, and in River the figures were 62 and 13·86 respectively. Further details are given in a table in the paper.

In a second table the author cites experimental work done in three countries as to the amount of damage which mosaic can do to the crop. In each case equal areas were planted with thoroughly healthy cane seed and with seed taken from infected plants; the comparison is thus between 100 per cent. infected fields and those in which the disease was entirely absent, and represents more or less the maximum loss to be expected by sowing seed from plants attacked by mosaic. In the Philippines, Atherton Lee found that the loss induced in sugar yield was 40 per cent. in Badila, while in one plot of Negros Purple it was 60 per cent. and another only 14. In Hawaii, Kunkel found that the decrease in tonnage of canes was 78 per cent. in Badila, 36 in H 109, 72 in Lahaina, 41 in D 1135 and 83 in Striped Tip. Lastly, in Louisiana, the author himself, working on the weight of individual canes, met with decreases of 38 per cent. in Purple, 19 in Ribbon, 18 in

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[1] Mosaic's Role in limiting Louisiana's Yield. E. W. Brandes. *Facts about Sugar*, 28th June, 1924.

D 74, 29 in D 95 and 10 in L 511. In passing, one might point to the curious fact that the damage done appears to be very much greater in Hawaii than in Louisiana, and also that the two figures for Negros Purple are extraordinarily divergent; but in spite of these discrepancies there can be no doubt as to the general deleterious effect of the mosaic disease on crop production.

The author then proceeds to discuss the means taken in Louisiana by the United States Agricultural Department to cope with the evil, incidentally mentioning the apathy of the planters in the matter when it was brought to their attention in a bulletin containing full information and the method to be adopted in controlling the disease. BRANDES commenced a world wide study of the disease, with the idea of obtaining a thorough knowledge of any varieties which showed definite resistance to mosaic. About 100 varieties were thus collected, many of them by personal visits to their country of origin; and these were submitted to comparative tests among themselves and with the standard canes being grown on the plantations. For purposes of quarantine, the experiments were conducted in a special series of greenhouses in Washington and thus far removed from the sugar cane area. As a result of this work it was found that the bulk of the introduced canes were in no sense more resistant than D 74, Ribbon and Purple canes, and the rest were classified into three categories with regard to the nature of their resistance. Under *Immune* were those on which mosaic obtained no hold whatever; under *Resistant* were placed those varieties which were attacked with difficulty, but once attacked suffered from the disease; and under *Tolerant* those which readily took the infection but were little affected by it. The following is the list given:—

Immune: Kassoer, Tjepring 24, Toledo, Uba, Kavangire, Cayan 10, Merthi, Kinar, Oshima, Yontansan.
Resistant: P O J 2714, 2725, 2727, and D 1135.
Tolerant: P O J 36, 100, 213, 228, 234, 826, 979, 1228, and 2379.

Meanwhile the raising of seedlings from these varieties was undertaken, after a quarantine period at Washington which was considered sufficient. Owing to the climate of the sugar belt in Louisiana seedlings are not readily produced there, but in the Everglades region of South Florida the conditions were found to be favourable. It will be remembered that, as mosaic is not supposed to be transmissible by seed, there would appear to be little danger of introducing the mosaic afresh with these seedlings into the Louisiana fields. The author states that already some thousands of selfed seedlings have been sent to Baton Rouge together with several hundreds of crosses, and these numbers will be shortly increased. Interesting results may soon be made public from these experiments. Supposing satisfactory seedlings are produced, unaffected by mosaic and worth cultivating in the Louisiana tract, the question of the replacement of the standard varieties will have to be tackled. And the author fully recognizes the difficulties involved, in that he has left it undecided whether to commence with such more resistant varieties as are obtainable and then give out the more perfect form, or to do this at once. In the former case there would be two periods during which the standard canes would be changed, and in the latter only one; and the comparative suitability of these two courses in the local conditions is a distinctly debatable question.

C. A. B.

Dr. GEORG STRAKOSCH, of Hohenau, Austria, a well-known beet technologist, has stated that at his factory the introduction of pressure evaporation saved 33 per cent. of steam, and paid for itself during the first season.

Streak Disease in Uba Cane in Natal.

Streak disease was discovered a year ago by H. H. STOREY, the South African Government mycologist, and now that he has given it a year's study, definite pronouncements can be made regarding it. His present paper[1] summarizes the main results in a popular form avoiding all technicalities. The two main conclusions arrived at are, in the first place, that streak is a new disease, not described as occurring anywhere else, and secondly, that it resembles mosaic in many respects but is quite different from it: it is considered probable that it is caused by an ultramicroscopic organism. The symptoms are the presence of narrow, irregular streaks all over the leaves of the shoot down to the youngest. When held up to the light, these streaks are seen to be almost transparent (hence sometimes termed "windows"), whereas in the markings of mosaic there is always some green or yellow. Like mosaic it is incurable: once in the plant it remains there, and thus it is always reproduced by cuttings from affected plants. Secondary infection also takes place, but to all appearance less readily than in mosaic; it varies in degree and rapidity, remaining stationary for months at a time and at other times spreads widely and rapidly. It is regarded as probable that this secondary infection is brought about by an insect carrier as in mosaic.

Streak disease is not devastating, and the question arises whether control measures, always expensive, are justifiable. From repeated observations and weighments the author estimates that, on the average, the damage done to the plant amounts to about 10 per cent., although there are indications that it is often considerably higher. A simple study of any partly infected field will at once reveal the plants attacked, and some wonder is expressed that it has escaped the notice of planters. Probably in the course of time all the fields of Uba will be affected, and it is a question for the planters to decide whether, in these days of striving after efficiency in the fields, such a toll can be accepted with equanimity. The answer would seem to be fairly obvious. The remedy is of course, as in mosaic, to plant nothing but healthy cane. This is simple, but the building up of such a supply is by no means so easy. To assist in the work the author would consent if required to work out a system of certificates for all plantations or fields, and suggests the following classes indicating the relative soundness of the canes for furnishing sets :—(A 1) Canes raised from absolutely clean canes in an absolutely clean area ; (A 2) Canes from fields absolutely free from disease at the time of cutting, but where roguing has taken place, or within 400 yards of an infected field ; and (B) Canes raised from fields where the infection is under 2 per cent. The first should give healthy seed with practical certainty, but the second and third would need careful watching, with the probability of a certain small amount of roguing. The method of this roguing would be exactly the same as in mosaic. The author concludes his paper by stating his belief that the establishment of isolated nurseries for sound seed would probably be a profitable undertaking, even if it involved considerable expense. He mentions a case of a farmer in Java who went to the expense of roguing a nursery which was infected by mosaic to the extent of 80 per cent., rather than lose his name for the supply of good seed.

STOREY reports this disease as widely spread all over the Natal sugar fields, and baldly expresses the opinion that this hitherto profitable cane, the Uba, is on the verge of collapse. His discovery, it seems to the writer, suggests the advisability of a thorough examination of the fields, especially in Zululand, for the presence of other diseases. C.A.B.

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[1] Streak Disease in Uba Cane. H. H. STOREY, Government Mycologist, Durban. *South African Sugar Journal.* Congress Number, June, 1924.

Mill Trials of Coimbatore Sugar Cane Seedlings 232 and 233.[1]

By WYNNE SAYER, B.A.,
Secretary, Sugar Bureau, Pusa.

In a previous article entitled "Mill Trials of Selected Coimbatore Seedlings" published in this Journal,[2] the present writer has fully described the nature of the testing work on cane being done and the method of cane growing followed at Pusa and the importance of the factory tests which are arranged for, with a view to obtain reliable data for the guidance both of the sugar industry and the cane growers. It is, therefore, not proposed to repeat the details given there. Suffice it to say that by the method of short planting successfully adopted at Pusa, two new varieties, Co 232 and Co 233, were rapidly multiplied, and three acres under the former and one acre under the latter were put down in February, 1923. The crop was grown in a rather sandy field at Birowlie about two miles away from Pusa, which was rented for the purpose. As usual, the cane was planted in February according to the Pusa method described in the article already referred to and was cut on the 18th December. Half a ton of castor cake per acre was given at the time of planting and a dressing of another half ton given at the break of the rains. The canes were grown without irrigation but they stood the hot weather remarkably well. Unfortunately the rainfall of 1923 was most disappointing in this part of North Bihar, only 26 inches of rain being registered against an average of 45 inches. Even then while the local cane *Bhurli* suffered badly, these canes gave a fair yield. While these canes grew well, the deficiency in rainfall was extremely marked when it came to the actual tonnage weight. The canes grew to a good height but failed to swell to the normal extent in an average year, and it is perfectly evident that, however well a cane may withstand drought, actual tonnage is linked to the rainfall. In North Bihar, cane is grown without irrigation and any great deficiency in the rainfall, such as occurred this year, is bound to be shown in the yield, however strong the cane may be. 360 maunds[3] stripped cane per acre was obtained in the case of Co 232, while Co 233 yielded only 220 maunds. The whole crop was practically free from any insect pest or fungus disease. It was evident that Co 233 is not able to withstand such conditions, and further tests on this cane will be discontinued.

Both Co 232 and Co 233 are seedlings of the same parents—P.O.J. 213 and Katha (a Punjab cane)—but they vary in a number of characters. Co 232 is a straight growing and early ripening cane with fair vigour and good habit, but it has not been found to tiller so well as Co 213 or Co 210. It is too early yet to pronounce definitely regarding this cane owing to the abnormality of the season in this part of Bihar. As it is highly important to have an early cane to replace Co 214 if the latter shows signs of deterioration or tends to emphasize its present twisted habit in the cultivators' fields, the writer has again put down three acres of this cane in 1924 with a view to find out whether, in point of tonnage, it comes up to the standard of Co 214, i.e., to at least 20 tons per acre. Co 232 is an early cane of erect growth and if it proves a good tonnage cane in a normal season, it can be used to supersede Co 214, but at present no definite decision can be arrived at on this point. It is necessary to emphasize that the great desideratum of the white sugar tract in India is an early cane with a fair tonnage. Growers will not take up a cane, however early, which is much inferior to Co 213 or Co 210 in tonnage, and factories do not want a cane the juice of which shows low purity.

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[1] Reprinted from the *Agricultural Journal of India*, Vol. XIX, Part IV.

[2] Vol XVIII, Part III.

[3] 1 maund = 82·28 lb.

To return to the mill trials. As mentioned above, both these canes are early ripening, and the short rainfall undoubtedly hastened their maturity. It was, however, unfortunately not possible to arrange for a mill trial till the 19th of December when they were put through the Champaran Sugar Factory at Barrah—such delay always militates against a really early ripening cane—and by the time they were crushed both canes were over-ripe. The following are the results of the mill trial:—

I

	Cane mds.	Sugar per cent. on cane.	Fibre per cent. on cane.
Co 232	932	12·65	15·55
Co 233	148	10·35	17·13

II

Analysis of first juice.

	Brix.	Purity.
Co 232	21·00	77·61
Co 233	20·00	69·50

III

Analysis of mixed juice.

	Cane mds	Brix.	Sugar.	Purity.
Co 232	716	19·20	14·20	73·95
Co 233	121	16·00	10·49	65·56

It will be seen that Co 232 is better in the mill than Co 233, but even Co 232 does not in these results show itself to be very desirable from the factory point of view; while the Brix of the first juice was 21, the purity was only 77, and the percentage of fibre, 15·5, is higher than the mills like.

To sum up. The result of this year's experiment has been to prove that in Co 232 we have a fairly tall, straight growing cane with the character of early ripening and a good sucrose content. It now remains to find out whether in a normal season it will yield about 6000 maunds of stripped cane per acre, and whether healthy well-grown cane of this variety when subjected to a mill trial when fully mature shows better purity. It has already been mentioned above that much of the cane supplied to the factory was over-ripe, and hence the analytical results require further confirmation by comparison with the results obtained with a crop grown under normal conditions of rainfall and crushed at the right time. It is proposed to have such a test carried out in November next along with further tests of other canes.

In conclusion, the writer wishes to express his obligations to Messrs. Begg, Sutherland & Co., Cawnpore, not only for financing this experiment but also for allowing the mill trial to be carried out at their factory, and to Mr. NOEL DEERR, Sugar Technologist, for valuable assistance rendered in connexion with these mill trials.

At Wembley Exhibition, London, interest is being taken in the "Hydrautomat" pump, which "develops the energy of low falls to raise water, the water being lifted any desired height . . . . the quantity being anything up to a certain limit, depending on the amount flowing over the fall." Any fall upward of 2 ft. is suitable. It is claimed that it will ultimately displace, where a fall exists, all other forms of pumping, and that it should find a wide application for such agricultural purposes as irrigation and drainage. Compressed air is involved in its working, and the machine is simple in construction and stated to be efficient in operation.

Difficulties in the Crushing of Uba Cane.[1]

By S. TRESIZE,

Amatikulu Factory, Natal.

Many difficulties are encountered in handling and crushing sugar cane in every cane growing country, but in South Africa we have our share due to the exceptional hardness of the Uba cane.

In wholly tropical countries the cane is almost invariably of the soft kind, the fibre being in some cases as low as 7 per cent., but averaging, shall we say, between 10 and 12 per cent. As we get a fibre content of 17 per cent., one must agree that the extra percentage of fibre means more strain on the engineering plant, causing a greater amount of wear and tear to the machinery, and necessitating a higher motive power for crushing purposes. If, together with our large fibre content, we had a larger sucrose content than other countries, then we would be lucky indeed. But unfortunately this is not the case, our sucrose content being practically identical with that of Cuba, viz., averaging about 13 per cent. This is one of our greatest difficulties in competition with the sugar industries of other countries.

TRANSFERRING CANE TO CARRIER.

Co-existent with the arrival of the cane in the truck at the cane-carrier are difficulties in transferring the cane to the carrier. In some instances the cane is off-loaded from the truck on to a platform by a crane, and then raked by labourers upon the carrier. This double handling is not productive of efficiency in two ways: it requires more labour, and it twists the cane in the carrier, causing sticks to lie at right angles to their proper position, the root evil of an irregular feed to the crushers with the consequent bad feeding of the mills, and poor extraction. In other instances the cane is off-loaded in one operation from the truck to the carrier by a grab suspended from an overhead crane. This latter method obviates handling twice. Yet with each grabful care has to be taken to see that the grab is swung in the correct position to drop the cane parallel to the carrier. A fraction of time is lost with almost every grab-load, in getting alignment; and, taken over a period of 24 hours, this means a considerable loss to the feed. Besides this, when the interval between grab-loads is longer than usual, there is an abnormal gap between the cane in carrier, and the continuous feed of the crusher is periodically interfered with. These almost un-noticed delays in the aggregate present a serious loss of time.

Again in reference to the method of off-loading by grab the factors employed are so many, and the calculation to pick up and drop the cane in the correct position is so much, that one wonders if the compensation is adequate to the work done, especially when all the cane crushed has to be lifted bodily from the trucks, necessitating the usage of a considerable amount of power.

The first step taken in Cuba to arrive at a better means of off-loading cane into the carrier was to insist that it be cut into lengths of from 3 to 4 ft., thus doing away with the trouble caused by twisted canes. The next was in using trucks in which the cane had to be loaded lengthwise; that is, supposing the truck when alongside to be parallel to the carrier, then the canes are also lying parallel to the carrier, and in the proper position to enter the mill. It then became a matter of rolling the cane from the trucks into the carrier.

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[1] Summary of a paper read before the Congress of the South African Sugar Industry, Durban, 1924 : *South African Sugar Journal*, 1924, 23-27.

Difficulties in the Crushing of Uba Cane.

First of all trucks with collapsible sides were used, and a mechanical rake was utilized to pull the cane from the trucks into the carrier; but now almost the only system in use at Cuba is a truck with the sides hinged at the top. The truck is brought alongside the carrier on to a tipping table, worked either by hydraulic or hand power, the hinged sides are released, the table gradually tilted, and the cane rolls from the truck into the carrier.

There is a saving in labour with this system. A milling plant, crushing 1500 tons per day, can be fed by at most eight labourers at the cane carrier. For various reasons (though now impossible or impracticable) it is somewhat difficult to immediately change over to this system from our present one. I have drawings of a scheme very nearly approaching the Cuban method, and it is the opinion of engineers that some such method must eventually supersede the existing one.

Because of the twisted and crossed canes in the carrier, revolving cane knives were introduced. When working above the carrier, the cane is cut and lacerated from the top downwards to a safe distance from the surface of the carrier. Possibly the amount of twisted cane which passes under the knives is reduced almost to a minimum, and the condition of twisted cane which the crusher otherwise would have to contend with is alleviated. Yet with this as with most introductions there is diverse opinion. Many contend that the chips and fragments resulting from the working of the knives block and fall through the carrier slats; and that the motive power employed to run the knives (approximately 40 h.p. for a set of knives capable of dealing with 1000 to 1200 tons of cane per 24 hours) may be more usefully employed in other parts of the factory.

One other point concerning the carrier. In the case of a first crusher being set so high above floor level, care should be taken to erect the carrier, immediately adjoining the crusher, at such an angle that "slip" may not take place in the event of a twisted over-load of cane. Occasionally, especially in wet weather, this slip may happen, the carrier travelling at its usual speed, and the cane, owing to its being twisted and hanging over the sides of the carrier, partly supported by the carrier sides, remaining stationary. In such an instance the cane may be again set travelling by the simple (yet effective) expedient of nailing wooden strips two or three yards apart, around the whole length of the carrier. One should bear in mind that in no circumstance should the incline exceed an angle of 16° from the horizontal. Before finally leaving the subject of the cane carrier, I may say that we have followed the lead of other countries in the matter of independent cane carrier, by drive by variable speed engine or motor. To be able to stop and start at will ensures a more regular and positive feed, obviating to a big extent feed errors. The advantages of this type of drive are too well appreciated to require any elaboration.

TYPES OF CRUSHERS.

The selection of the best all-round type of crushers to prepare the cane for the mills has been a difficult problem for a very long time. During recent years the extraordinary extractions and capacities obtained in other countries have caused us to somewhat change our ideas. Many of the later factories, in Cuba and other parts showing good results, have crushing plants consisting of one crusher and four mills, but the very latest factories have generally been equipped with two crushers and five or six mills. The comparison of results between old time efforts and multiple crushing is so striking that we are satisfied that the newer method is by far the better in many respects, and undoubtedly pays.

If then it has been found expedient in Cuba when crushing a soft cane (possessing 10·5 per cent. of fibre) to instal so extensive a crushing plant; and also, if it has been proved a payable proposition, one would surely conclude that in this country with our fibre content as high as 17 per cent. it would be even more advantageous to have the fullest train of mills. Of course one must also bear in mind that the introduction of multiple crushing has a direct relationship to fuel consumption. Practically every large factory in Cuba has to burn extra fuel. Despite this, and considering that the price of coal in Cuba is extremely high, it is evident that the results obtained warrant the expenditure in extra fuel required. With such a high fibre content, and consequently a much larger supply of bagasse, it follows that we ought to be able to extend our milling plants without the same necessity for considering expenditure on extra fuel. At the same time it must be pointed out that much more power is required to obtain the same percentage of sugar extraction from a hard cane such as the Uba than from the soft cane grown in Cuba; so that the larger quantity of bagasse produced in this country does not actually represent the reserve of fuel which may be counted upon for the extra power required. Therefore, in considering the advisability of introducing multiple crushing to the extent which is carried out in Cuba, the question of a sufficiency of, or expenditure for, extra fuel must not altogether be lost sight of by us.

In dealing with the "hardness" of our Uba cane, the industry has been looking out for a perfect crusher or roller—a roller that would "bite" at a maximum feed of cane; a roller that would "flow-through" the juice and eliminate re-absorption; a roller that is made of sufficiently hard and tough material to stand up to excessive pressure; and a roller that has homogeneous structure and yet is rough enough to do away with slip. This is what operators want, to give the best results to owners. It is vital to our industry also that builders should concentrate on the design of equipment that can be quickly and conveniently adjusted, dismantled and re-assembled.

MILL DESIGN.

In connexion with design related to roller adjustment, some builders have constructed their headstocks with such a shallow housing for the bottom roller brasses that when adjustment is necessary through having turned down the rollers, it is almost questionable whether the roller will run the season without the journal coming into contact with the inside of the housing. The danger of this happening is even greater should one desire to change the shallow-grooved surface into an intermeshing one. No extra labour or expense would be entailed when casting the headstock if an adequate gap were left, ensuring a safe margin for future adjustment. With respect to the shrouding on the cast steel roller, one fails to see why this is left so deep. Again when the roller has been turned, and close adjustment is necessary, the shrouding has to be turned down; and when one has no big lathe at the mill, it sometimes means a long journey by rail to an engineering centre, irrespective of the cost of the shrouding being turned.

Concerning crusher equipment, many engineers contend to-day that compound springs and the like are out of date, and that hydraulic pressure regulators should be used to maintain a uniform pressure exerted on the rollers. There is much logic on the side of this contention. To obtain the correct and equal temper in each spring is extremely difficult; whilst many makers state that their springs of a size are of equal strength, yet it is patent practice that this is not so. Many times have springs of a size been used separately to do a stated work and in each case with different results. Again, if the crusher springs are of equal hardness, the tension alters with the variable load, so that the strain is never for a moment constant.

In the use of hydraulic pressure as applied to crusher rollers, it is common to have pinions at each end of the shaft, thereby obviating to a certain extent unequal pressure across the face of the rollers. If the pinions are only on one side of the shaft, then naturally the amount of cane between the rollers together with the thrust of the pinions causes a greater exertion and consequently a greater gap on that particular side than on the opposite end which has no pinion, the result being less extraction at one side than the other, to say but little of unequal stress on the machinery parts. This unequal pressure on either side of the mill due to the thrust of the pinions is the beginning of various troubles.

Up to a certain point we may do away with this by the use of separate hydraulic pressure at each end of the mill, the accumulators being loaded by trial and error to obtain an equal travel on both sides of the mills. I find on checking up hydraulic loads carried by our mills, as compared with foreign builders who are recording very high extractions, that we operate our mills at approximately half the pressure found on many mills in the West Indies, Hawaii, etc. This is a very important item and should have our serious thought and attention. Even though this would mean greater strain to the machinery, the extraction might warrant it.

Grooving of Rollers and Setting of Mills.

With reference to the size and design of grooving most adaptable, many of us are still in doubt. Very many of the forms of grooves as found in practice resemble every figure in Euclid. Many which helped us on our way are now thrown out, others have been added to by chevrons thrown across or around them; but, as regards our hard cane, designers are not so confident that they have arrived at a perfect conclusion.

The setting of rolls and trash plates demands the utmost care and skill. Formulæ are given for the setting of rollers and trash plates of rigid mills. It would be possible for two rigid mills of equal capacity, crushing a pre-determined quality of cane, and all other conditions being equal, to accept these formulæ as a basis upon which to commence the operation of crushing; but even then I doubt whether the actual results would be the same. In engineering construction, especially in a large and complex plant, so many factors have to be taken into consideration that it is next to impossible to turn out two plants alike in every detail, of actual practice. Even the molecular construction of rollers, although from the same maker, may cause slip through having too close-grained a metal; or because of the component metals not being thoroughly mixed in the furnace, a roller may bite in one part and slip in another. It is not singular for the framework of a power engine to warp after it has commenced running, throwing undue strain on perhaps an important bearing, causing extra power to be used or less work to be accomplished.

When one considers that the capacity of a mill is affected and sometimes very seriously, by such factors as brittleness of cane, fibre content, roughness of the rollers, slip, setting of trash bar, speed of carrier feed, etc., and that certain of these deterrent factors may be counteracted by increasing or decreasing the gap between the rollers, or by raising or lowering the trash-plate, then one naturally is wary of suggesting any given setting. Every mill has a constitution peculiar to itself, and the human element looms large in success or failure.

To refer briefly to the transferring of "cush-cush" (after it has been raised to the required height to be traversed over the intermediate carriers) I have noticed that more breakdowns occur with the endless chain-and-paddle system than with the Archimedean screw and casing. In the case of the former the links often break, and should one allow the chain to become a little slack when a slightly undue amount of "cush-cush" has to be traversed, it is not unusual for a link to draw out from another, disconnecting the chain, and mixing paddles, chain and "cush-cush" in a heap before one has time to throw out the clutch. The same results obtain if a paddle (as is sometimes the case) gets separated from the chain through a broken bolt. With reference to the Archimedean screw and casing, the up-keep is not so expensive. During the whole of a crushing season I have seen this system work without causing a moment's stoppage; and time is money.

LUBRICATION.

When stating engineering difficulties, and methods of overcoming them, it would not be wise to leave out entirely the subject of lubrication. In the lubrication of mill roll bearings we have to solve the question of large bearings, low journal speeds, fluctuating temperatures caused by the state of feed to rollers and other attributes, accompanied in the case of the top roller with very heavy fluctuating pressures. The pressure exerted against the bearing surface of the two top brasses reaches the neighbourhood of 380 tons. The objection of lubrication is naturally to altogether eliminate solid friction which would result from metal to metal contact of journal and bearing. We endeavour to do this by interposing a lubricating film. Now it is practically impossible to altogether eliminate friction between journal and bearing of mill rollers; the consistency of any lubricant is such that it cannot possess the capacity to hold off absolutely a a heavy rotating journal from a bearing, and at the same time to be of sufficient fluidity and softness to flow around and lubricate. Therefore we have to find out the correct medium, shall we say a lubricant that will keep journal apart from bearing, with the least possible space between, and at the same time possessing fluidity and softness to effectively lubricate. If it were possible to get an oil which will absolutely keep bearing away from journal, and at the same time flow and thoroughly lubricate, then we should still have friction resulting from the movement of the molecules in the lubricating film. The extent of this friction, which we may term "fluid friction," will depend upon the consistency of the oil used. Generally speaking, we may say that the comparison of the fluid friction in lubricating oil will vary as does the body of the lubricant. The lighter bodied oils will spread easily in a smooth film, and the fluid friction in such a film will be low. The lubricant with a greater viscosity supplies a heavier film, and more agitation of the molecules is required to cause it to flow—thereby proportionately increasing the fluid friction.

In all manufacturing plants, the economies in the power required to operate machinery and, in the consumption of a lubricant, have an important bearing on the cost of production of the article in manufacture. Thorough perfect lubrication, permitting the continuous operation of a plant at maximum capacity over long periods of time, also has a marked effect on the cost of production, since the time-losses and expense due to stoppage and repairs are entirely obviated. I am pleased to notice that owners are fitting force-feed lubrication to their mill bearings and sparing no effort in obtaining the best possible lubricant, and so saving future expenses and delay.

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Pioneer Mill, T. H., turned out last crop 34,529 tons of sugar, a record for this factory. Oahu Sugar Co., on its Field 43, comprising about 600 acres, planted with D1135 cane. obtained an average yield of 12·01 tons of sugar per acre, claimed to be a record for this variety in Hawaii; while on the same Estate, on Field 44, H109 gave an average of 14·85 tons.

The Cause of the Low Yield of Alcohol in the Fermentation of Cane Molasses.[1]

By D. N. GUPTA, M.Sc., and E. R. WATSON, M.A., D.Sc.,
of the Technological Institute, Cawnpore, India.

It has been shown that the yield of alcohol from the fermentation of molasses is always considerably less than that expected from the analysis of the molasses; that this low yield is probably not due to bad conditions of fermentation, bacterial infection, etc., because in Indian distilleries the yield of alcohol from *mohua* flowers is much nearer to that expected from analysis; and that the spent wash from molasses is able to reduce a considerable amount of Fehling's solution.

The object of this investigation was to ascertain the cause of this low yield of alcohol and, if possible, to find a means of improving the yield.

HARKER[2] came to the conclusion that the non-fermentable reducing substances, returned as reducing sugar in the analysis of molasses, and left in the spent wash, are not sufficient to account for the low yield of alcohol, and that these substances do not inhibit complete fermentation of the sugars. In his opinion some substance returned as sucrose both by optical and reduction methods is destroyed during fermentation without giving any alcohol, even under conditions giving a very good yield of alcohol from sucrose.

FERMENTATION EXPERIMENTS.

All our experiments were made with a sample of molasses from the manufacture of sugar from Indian *ghur*. It gave the following figures on analysis:—Reducing sugars, 17·8 per cent.; sucrose (by Clerget's process), 37·4 per cent; other organic matter (non-sugars), 14·6 per cent.; ash, 6·5 per cent.; water, 23·7 per cent.

For analysis, the molasses solution was purified by treatment with normal lead acetate, the excess of lead was removed by disodium phosphate or hydrogen sulphide, and the cupric reduction method (volumetric and gravimetric) and polarimetric method were employed for determining sugar, the inversion being effected by invertase in preference to acids. The reducing sugars were determined by the cupric reduction method and the sucrose by the polarimetric method, using Clerget's formula for calculation. The total sugar as reducing sugar was obtained by adding the amount of reducing sugars and the equivalent of the sucrose. The total sugar as reducing sugar was also determined directly by the cupric reduction method, the inversion being effected by invertase. The two methods gave 57·2 and 56·8 per cent. respectively, and the mean, 57·0 per cent., was taken as the percentage of reducing sugar in the molasses. As pointed out by HARKER,[3] the amount of reducing sugar returned is higher—viz., 59·3 per cent.—if the inversion is effected by acid.

A. Large-scale fermentation.—The weight of molasses used was 2545 kg., the volume of wash 1732 litres. Initial sp. gr. 1·0491, final sp. gr. 1·0132,; 500 c.c. of wash were distilled, and the distillate was made up to 500 c.c. The alcoholic distillate had a density of 0·9935. These 2545 kg. of molasses contained sucrose and reducing sugars equal to a total of 1450 kg. of reducing sugars, which, according to PASTEUR, should yield 718 kg. of alcohol. The actual yield was 620 kg., or 86·3 per cent. of Pasteur's maximum practical yield. (Figures supplied by the Indian Distillery Co., Cawnpore.)

B. Semi-large-scale fermentation.—Molasses used, 17·24 kg.; initial sp. gr. of wash, 1·054; final, 1·018. Volume of alcohol obtained, 4·2 litres of a density of

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[1] *Journal of the Society of Chemical Industry*, 1924, 43, No. 38, 291-292T, here slightly abridged.
[2] *Ibid.*, 1906, 831. [3] *Loc. cit.*

0·825 and 2·5 litres of 0·945. These 17·24 kg. of molasses contained the equivalent of 9·82 kg. of reducing sugars which, according to PASTEUR, should yield 4·86 kg. of alcohol. The actual yield was 3·97 kg. of alcohol, or 81·6 per cent.

C. Laboratory fermentation.—All precautions were taken to sterilize the molasses by boiling and dissolving in boiled distilled water. The wort was pitched with active yeast obtained from the Indian Distillery Co., and fermentation was carried out at 33°–35°C. in previously sterilized bottles, the mouths being closed by cotton-wool.

Molasses used, 140 grms.; volume of wash, 760 c.c.; 0·5 grm. of ammonium sulphate and 0·2 c.c. of concentrated sulphuric acid were added. Initial sp. gr., 1·048 to 1·052; volume of active yeast solution added, 150 c.c.; total volume of fermented wash, 910 c.c.; final sp. gr., 1·016 to 1·020; volume of active wash reserved for next batch, 150 c.c.; volume of water distilled, 760 c.c.

A series of eight experiments was carried out. The yield of alcohol obtained in each experiment is recorded in column 2 of the following table, and the yield expressed as a percentage of Pasteur's maximum practical yield in column 3. The reducing power of the spent wash was determined in each experiment, and the equivalent of reducing sugar is recorded in column 4. In column 5 is given the corrected value for sugar in the molasses, obtained by subtracting the amount of reducing substance in the spent wash from the original figure for reducing sugars in the molasses, and in column 6 is given the yield of alcohol reckoned from the corrected value for sugar in the molasses, and expressed as percentage of Pasteur's maximum practical yield.

No. of Experiment.	Yield of Alcohol, grms.	Alcohol as per cent of Maximum Yield.	Reducing Power of Spent Wash.	Sugar in Molasses (Corrected).	Yield of Alcohol from Corrected Value.
1	32·4	82·0	12·4	67·4	99·2
2	33·1	83·8	10·8	69·0	99·0
3	31·7	80·2	11·6	68·2	95·9
4	32·5	82·3	12·0	67·8	98·9
5	32·9	83·3	10·5	69·3	98·0
6	33·6	85·1	10·2	69·6	99·6
7	31·0	78·5	12·8	67·0	95·4
8	33·0	83·5	10·6	69·2	98·4

These figures show that the reducing substance left in the spent wash entirely accounts for the low yield of alcohol from the molasses.

This result is in direct contradiction to that obtained by HARKER.[1] He does not mention the source of the molasses examined, but it contained more ash and less reducing sugars than our sample, and, especially, it gave much less reducing substance in the spent wash—viz., 2·46 per cent. on the weight of molasses, whilst our sample gave 8·1 per cent.

NATURE OF THE REDUCING SUBSTANCES IN SPENT WASH.

Pentoses.—It appeared possible that the reducing substances left in the spent wash might be sugars such as pentoses unfermented by ordinary yeast. The original molasses gave the furfural test for pentose and the spent wash gave a small quantity of osazone which, on purification melted at 156–158° (*cf.* arabinosazone, m.p. 158°, xylosazone, m.p. 158°).

Pentoses were determined in the original molasses by the method of GUNTHER, DE CHALMOT and TOLLENS,[2] and found to be present to the extent of 1·2 per cent.

Glutose.—This unfermentable sugar has been found in sugar cane molasses in amounts varying from 1 to 5 per cent. as a result of the action of the lime used in clarification upon the invert sugar of the juice. Not being fermentable it is found as a constituent of the vinasse from molasses distilleries.[1] According to the literature glutose forms an osazone, and this was confirmed by preparing a sample of glutose, which gave a good yield of osazone, crystallizing in yellow, lustrous, silky needles, m.p. 181–182°. But, as the spent wash gives only a very small yield of osazone, of which the melting point corresponds to that of a pentosazone, it cannot contain any appreciable quantity of glutose.

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[1] *Loc. cit.*

[2] *Ber.*, 1891, **24**, 3575.

Organic acids.—These are all precipitated by normal lead acetate, whereas this reagent does not remove the reducing substances from the spent wash.

Gums.—A good deal of the dissolved matter is precipitated from the spent wash by strong alcohol, and, conversely, a good deal of solid is left on exhaustively extracting with alcohol the residue obtained by evaporating the spent wash to dryness. The reducing power resides chiefly in the fraction insoluble in alcohol—e.g., 100 grms. solid matter gave 57·5 grms. of residue insoluble in alcohol and 42·5 grms. extracted by alcohol; reducing substances in the insoluble residue (reckoned as reducing sugar), 15·6 grms.; in the substance extracted by alcohol, 4·4 grms. The substance insoluble in alcohol was oxidized by nitric acid (density 1·2) and gave a good yield of mucic acid—viz., 100 grms. gave 12·5 grms. of crude mucic acid which, on recrystallization, gave 3 grms. of pure mucic acid melting at 215°–216°, and a second crop of 2·6 grms. which almost entirely melted below 220°. This large yield of mucic acid proves that the reducing properties of the spent wash are chiefly due to a gum of the galactan type. In order to obtain further proof of this, the spent wash was hydrolysed with 5 per cent. sulphuric acid for 18–24 hours. Some increase in reducing power was at first observed, but after prolonged boiling the reducing power actually decreased. Even after this protracted hydrolysis the bulk of the gum remained unchanged, as was seen by its insolubility in alcohol. A portion of the hydrolysed spent wash, 2·5 grms. of reducing substance, yielded 0·5 grm. of crude osazone which was fractionally crystallized from acetone. Only one pure osazone could be isolated from it; this melted at 192–193° and was therefore *galactosazone*. The initial increase in reducing power followed by eventual decrease can be explained on the assumption that the gum is partly of the galactan and partly of the xylan type, and on hydrolysis it gives galactose and pentose, which latter is decomposed by protracted boiling with acid, giving furfuraldehyde.

Xylan is precipitated by lead acetate, and, moreover, is quickly hydrolysed on heating with dilute hydrochloric or sulphuric acid[2]; it cannot be the reducing substance which we have found in the spent wash, which is not precipitated by lead acetate and is very resistant to hydrolysis. Moreover, xylan would not yield mucic acid on oxidation.

Other gums which are mentioned as occurring in cane juice are dextran and levan produced by the action of bacteria. But these substances yield dextrose and levulose on hydrolysis and would not give mucic acid on hydrolysis.

CONCLUSION.

Therefore, this investigation has shown that in molasses prepared from Indian *ghur*, the low yield of alcohol on fermentation is almost entirely due to a gum, which, on account of its reducing properties, is returned as reducing sugar in the analysis of molasses. This gum is very resistant to acid hydrolysis and yields no dextrose or levulose on protracted acid hydrolysis. It gives a good yield of mucic acid, and is therefore partly of the galactan type. It may be a mixed gum of the galacto-xylan type.

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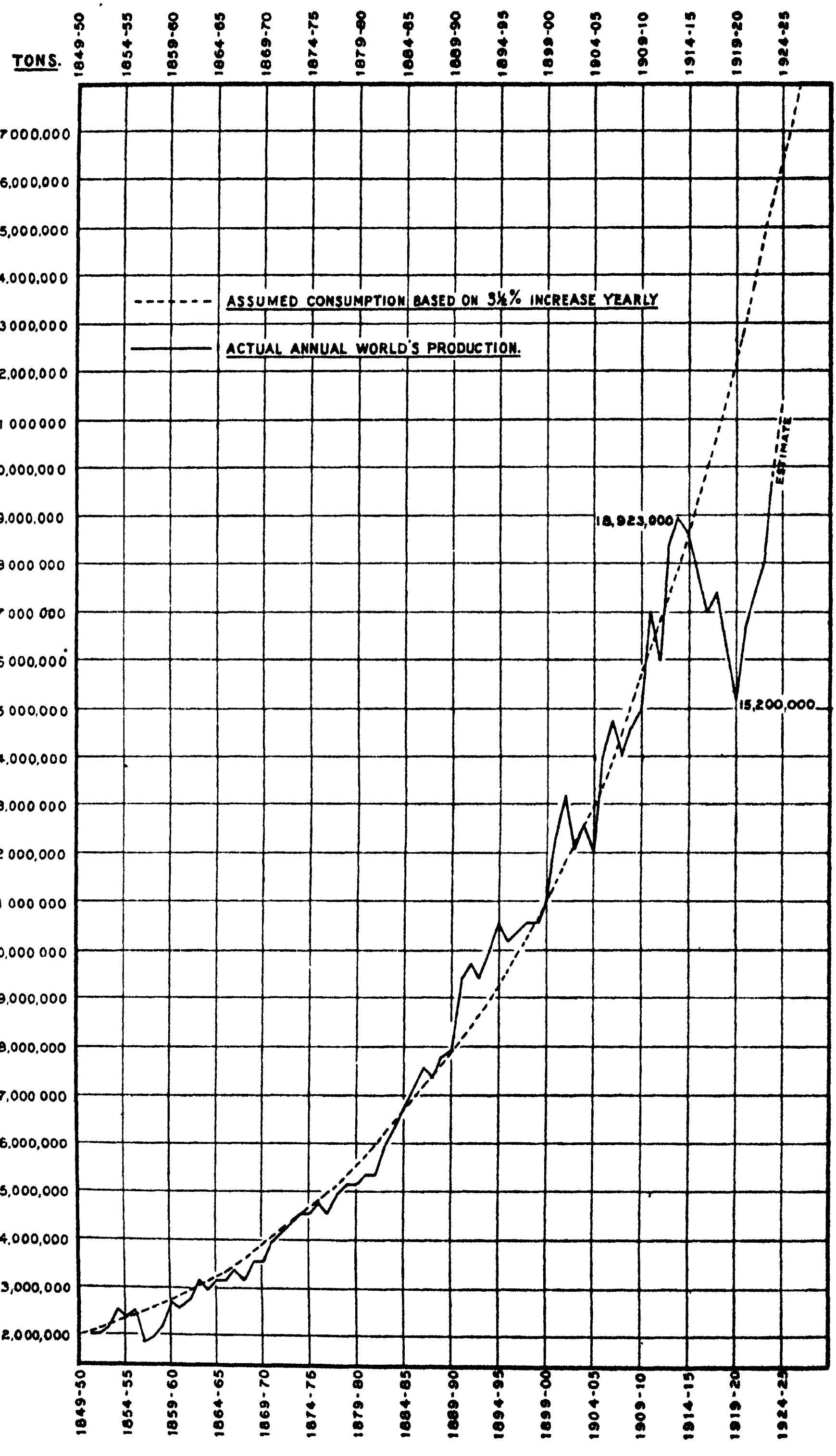
[1] PELLET, *Bull. Assoc. Chim. Sucr.*, 16, 1181; 19, 834; BROWNE, "*Handbook of Sugar Analysis*," p. 629.

[2] BROWNE, *loc. cit.*, p. 553.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ASSUMED CONSUMPTION BASED ON 3½% INCREASE YEARLY
ACTUAL ANNUAL WORLD'S PRODUCTION.
18,923,000
15,200,000
ESTIMATE

Sugar Production and Consumption.[1]

With the experience of five years of post-war conditions one is justified in reviewing the sugar situation on the assumption that both production and consumption have now had an opportunity of ranging themselves once again in line with the natural law of supply and demand, and the first question that arises is, owing to the natural sequence of its development having been broken down by the advent of the European war, how and when it will resume more settled or normal conditions.

With this end in view it is instructive to review the steady growth of sugar production over the past 75 years. The world's production in the year 1849-50 amounted to 2,000,000 tons; in 1914 it had grown to 19,000,000 tons. A careful analysis of the production for each of the intervening years reveals the remarkable fact that the *consumption of sugar has consistently increased by 3½ per cent. per annum* over the period. The adjoining chart shows this fact graphically. Naturally the production varied slightly, being sometimes more and sometimes less than what would seem to have been the normal world's requirements, and it is more than interesting to note that in looking into the records of the past years high and low prices campaigns synchronized exactly as the production was respectively below or above the figure based on a 3½ per cent. increase. With the experience of 65 years before us, during which time this consumption increase has been so marked and well defined, it would be idle to discard the assumption as a rough theory, and it would be more logical to accept the 3½ per cent. annual consumption increase as a well established fact.

The effect of the war on the sugar situation was at once to seriously curtail supplies and production, to unnaturally suppress consumption, and generally to abnormally restrict the free development of the article, with the result that in the year 1919-20 the sugar production had fallen to 15,200,000 tons, a figure approximately equal to that of the production ten years previously. From this date the world's markets having been relieved of the bonds of Government control and other abnormal influences, the law of supply and demand freely asserted itself, and the production rapidly increased during the following years until in 1923-24 it had reached 19,600,000 tons, representing *an annual increase of 7 per cent.* over the period. The world quickly absorbed this increased amount of sugar, which included this year's increase of 1,500,000 tons, and which has entirely disappeared during the present campaign.

It is considered in many quarters that the world's production in the coming year may possibly be 21,300,000 tons, being a further increase of 1,700,000 tons, the shadow of which has already shown itself in a range of prices that one might regard as those of over production, but is this justified? Let us for a moment consider what would probably have been the world's requirements had the war not interfered for five years with the normal development of consumption and production. A glance at the chart shows quite clearly that it would have been between 26,000,000 and 27,000,000 tons, or 5,000,000 tons more than the most sanguine estimate for the 1924-25 production. At first sight one is apt to dismiss this figure as fantastic, but a little consideration of the matter will soon encourage the idea that it is no less reasonable to have had a consumption of this figure—which in all probability would have grown to 30,000,000 tons in 1928—than it was to have had a consumption of 15,000,000 tons in 1908, or 7,500,000 tons in 1888 and so on. since on the basis which we have assumed it will be noticed that the consumption has actually doubled itself every 20 years with almost mathematical precision.

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[1] Reproduced from a Circular published by Arthur B. Hodge, of 21, Mincing Lane, London

One argument that can be used against this is that the consumption of sugar in 1914 had reached a point beyond which it is unlikely to increase by anything like the extent it had done formerly; but this opinion could surely have been advanced during any state of its progression, and there does not seem to be any valid reason peculiar to the present time on which one would be justified in basing such an assumption. It can also be argued that owing to the financial impoverishment of the world one can hardly expect an increase in purchasing power. Quite apart from the fact that the results of the past few years do not by any means confirm this view, the increase in the cost of living reacts quite as much, if not more so, on the producer as it does on the consumer.

The increase in the consumption of an article like sugar has really less relation to the actual increase in population than it has to the popularity which it gathers as a food or a luxury. Naturally to countries like the U.K., where habits and customs are more settled, one would hardly look for any material increase in consumption, where the amount consumed annually has already remained more or less constant for many years at about 85 lbs. per capita, but there is room for considerable expansion in other parts of Europe in which countries are gradually settling down to more normal conditions; and the possibilities of increase in the Continents of America and Africa are enormous, to say nothing of the almost unlimited demand which will without doubt materialize before long in Asia. The presence of the Eastern world troops in Europe during the war and the extent to which the Asiatic nationals are permeating Europe and America can only tend to hasten Western customs in food and living as in other things among the vast Eastern population. In short, the five years war period has without doubt temporarily stunted the natural growth of sugar production in the world, and as production recovers and improves there seems little fear of over production since statistics show—and the events of the last few years certainly appear to confirm—that the world is still hungry for sugar and will probably remain so until the vast leeway is recovered, which will take many years to accomplish fully.

One is very loath to attempt to draw definite conclusions from the foregoing, but if there be anything reliable in the assumption two broad deductions are clearly indicated :—

(1) Prices are not justified in falling to pre-war level while the average annual increase in production does not exceed reasonable dimensions, i.e., at least 1,000,000 tons yearly.

(2) Sugar cannot be considered to have recovered to its normal and true position until production has caught up to the figure to which it would have attained had it not been for the war interruption.

Ordinarily when the chemist takes a sample of massecuite, an error may be caused under certain conditions as the result of the crystallization taking place during the processes of sampling in the factory and filtering in the laboratory. J. G. THIEME,[1] therefore, uses a vacuum sampler, consisting essentially of a cylinder provided with a reservoir having a gauze filter. This apparatus is immersed in the massecuite, and connected to a vacuum filter, a sample of syrup or of molasses thus being immediately collected in the reservoir of the cylinder so that any chance of crystallization taking place is avoided.

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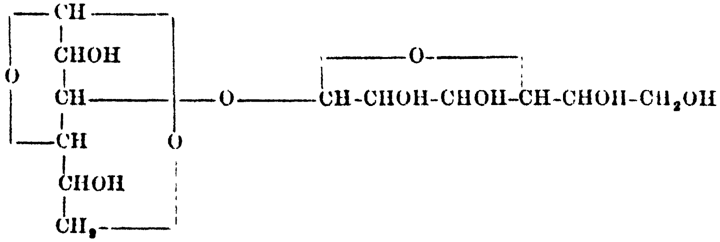
[1] *Archief*, 1924, 32, No. 13, 350-352.

Ithaca Meeting of the Sugar Section of the American Chemical Society.

The 68th Meeting of the American Chemical Society, held at Ithaca, September 8th to 13th, was a particularly successful one. Papers numerous and important, a very full gathering of members, the presence of a number of distinguished visitors, and the fine buildings and grounds of Cornell as a setting, combined to make it such. The Division of Sugar Chemistry held joint sessions with the Divisions of Cellulose and of Organic Chemistry, which were rendered notable by the presence of Principal **Irvine** (St. Andrew's University) and Prof. E. C. C. **Baly** (University of Liverpool). Following are short summaries of the most interesting of the papers presented.

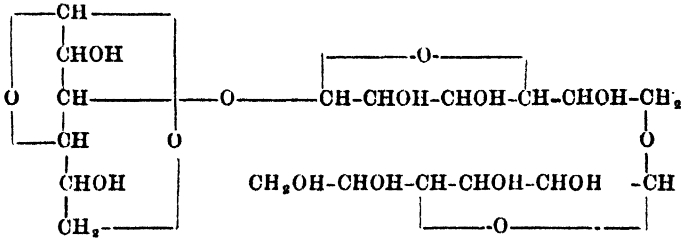
Constitution of synthetic dextrins.—*J. C. Irvine.* β-Glucosan has been polymerized by heating with a trace of zinc dust at 250° C. under diminished pressure, the atmosphere consisting of hydrogen. The products were: (A) Unpolymerized glucosan, 18; (B) Diglucosan, 25; and (C) Highly polymerized glucosan, 57 per cent. Exact separation was effected by methylating the mixture completely and distilling. Component A was isolated as trimethyl glucosan; component B was also distilled at 190-200°/0·2 mm. and had the composition of a trimethyl (diglucosan); and component C could not be distilled and was examined as an amber-coloured glass. It had the composition of a trimethyl (polyglucosan).

Trimethyl (diglucosan).—Hydrolysis gave tetramethyl glucose and dimethyl glucose in exact molecular proportions so that the diglucosan is an anhydro-glucose glucoside. The most probable structure is:—



Trimethyl (polyglucosan).—This, on hydrolysis, gave 2 : 5-dimethyl glucose 1 mol., 2 : 3 : 5-trimethyl glucose 1 mol., and 2 : 3 : 5 : 6-tetramethyl glucose 1 mol. There was no trace of 2 : 3 : 6-trimethyl glucose.

This result proves that the polyglucosan is based on a tri-saccharide unit in which a maltose residue is combined to a glucose residue:—



The theoretical significance of this deduction is important as two-thirds of the molecule resembles closely two-thirds of the unit of starch, the only difference being that the third glucose residue retains the anhydride ring characteristic of glucosan. Pictet's dextrins are therefore more closely related to natural dextrins than was anticipated. It is also noteworthy that the trimeride is produced in much greater proportion than the dimeride.

A study of certain abnormal rises in purity of cane juice during clarification.—***C. E. Coates and F. J. Robichaux.*** In certain sugar-house, increases in purity as high as three points or over are not infrequently reported. These rises are higher than seem possible. An explanation of them might be the transformation of any invert sugar into an inactive mixture of glucose, fructose, and mannose; but a series of experiments indicates that this transformation does not take place during ordinary clarification. Therefore, the conclusion is reached that these abnormal rises are due to constant errors in analysis, which in turn may be due to improper calibration of apparatus or to some constant error in manipulation.

Inversion losses during refining with vegetable carbons.—***C. F. Walton, Jr., M. A. McCalip, and W. F. Hornberger.*** In the preliminary investigation here reported, the conditions of time, temperature, acidity, and sucrose concentration customarily observed in boiling first massecuites in the procedure of refining raw sugar by use of vegetable carbons were closely duplicated in the laboratory, and analyses were made to determine whether inversion had occurred at varying degrees of acidity. Use was made of the laboratory vacuum pan previously described,[1] the temperature for boiling strikes being 180°F. and the time required being two hours. At a pH value of 6·00 determined by the colorimetric method at 15° Brix, corresponding to a titrated acidity of 2·3 c.c. of 0·N/100 NaOH per 10 c.c. of melt at 55° Brix, inversion was clearly indicated. When the pH of the melt was 6·70, corresponding to 0·60 c.c. of 0·N/100 NaOH per 10 c.c. of melt, no inversion could be detected by the precise analytical methods employed. The investigation is being continued in order to determine more closely the pH border-line at which inversion occurs in boiling first massecuite, and also to ascertain the initial degree of acidity at which the melt may safely be carried without danger of inversion in boiling subsequent massecuites.

Investigations of colloids in cane and beet sugar manufacture.—***H. S. Paine and M. S. Badollet.*** Data involving the following criteria and testing methods were obtained in an investigation of the colloids in cane and beet products: dialysis, ultrafiltration, cataphoresis, gold number, surface tension. Quantitative data were obtained relative to the amounts of colloids of predominantly emulsoid and suspensoid types in various beet and cane products. Information was gained regarding the approximate composition of various colloid fractions separated from different factory products. The data obtained have distinct constructive value in connexion with efforts to prevent or minimize production of off-colour sugar and to control colloid viscosity effects resulting in slow-boiling, retarded crystallization, etc.

The moisture absorption and caking of granulated sugar. ***M. J. Proffitt, V. C. Swicker, and J. Greenwald.*** Moisture retention curves of several specimens of commercial granulated cane and beet sugar are drawn from data obtained with samples of about 130 grms. contained in special weighing bulbs, using rapid streams of air at vapour tensions between 5 and 80 per cent. inclusive. All specimens show the same general type of curve, although there are some very noticeable differences, which seem to be important. By substituting pure sugar and "synthetic" films for the "natural" impure films on the surfaces of the crystals, it was shown that deleterious moisture absorption is due to the presence of the impure films. The experiments indicate that when sugar from the same specimen is dried from various degrees of dampness, the crushing strengths of the resulting cakes are almost a linear function of the moisture lost in the drying, but that this relation does not hold between different specimens of sugar, where there are differences in the shape and size of the crystals.

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[1] *I.S.J.*, 1923, 139.

Preliminary results on the utilization of Steffen waste water.—***W. J. Geldard.*** About 2,500,000 tons of this waste water are produced annually in the United States, and practically no effort is being made to utilize its chief valuable elements—potash and nitrogen. Up to a certain specific gravity, 1·38 at 28°C., the inorganic salts which separate during concentration are composed entirely of potassium compounds—chlorides, nitrates, and sulphates. Spectroscopic tests on recrystallized salts showed not over 0·001 per cent. of sodium salts to be present. A continuous evaporation test, based on probable commercial practice, gave a yield of 11·37 per cent. of crude, or 9·96 per cent. of recrystallized, salts, based on the weight of final concentrated waste water. In producing 1 ton of concentrated waste water (68 per cent. dry substance), there might be obtained 199·2 lbs. of recrystallized salts containing no sodium salts. These results are characteristic of one particular sample of waste water, and the sale of potassium salts would hardly pay for the total cost of evaporating the waste water from 3 per cent. to 68 per cent. dry substance. Other processes of treatment must be developed in order to make the complete utilization of the waste water profitable.

Industrial applications of invertase.—***H. S. Paine, C. F. Walton, Jr., and M. S. Badollet.*** Industrial procedures for the use of invertase as a sucrose-inverting agent have been developed in connexion with manufacture of the following products: cane syrup (including "la cuite"), sorghum syrup, maple syrup, maple "cream" (fondant), golden syrup, and confectionery. Invertase is frequently preferable to acids as an inverting agent in the case of products exhibiting considerable buffer effect, owing to the fact that the latter often necessitates such an increase in amount of acid as injuriously to affect flavour and sometimes colour. Invertase is now on the market in the United States in commercial quantities,[1] and its use industrially is rapidly extending. The cost of invertase is ordinarily 0·5 to 1·0 cent per gallon of syrup.

Method for the manufacture of levulose.—***R. F. Jackson, C. G. Silsbee, and M. J. Profitt.*** A process for preparation of levulose is described, which brings manufacturing costs within the range of possible commercial development. Jerusalem artichokes contain from 10·7 to 12·4 per cent. of levulose (after conversion), from which it can be manufactured in the following way:—Extracted juice is immediately acidified with enough H_2SO_4 to furnish a 0·2 N solution; converted at 70°C. for about 30 minutes; neutralized with lime to pH 7·5 to 8·0 and filtered, the filtrate, which has a levulose purity of about 60 per cent., being subjected to a modified process for the precipitation of calcium levulate. Lime and syrup are admitted to the reaction vessel simultaneously in small equivalent fractions, each entering portion being diluted to the volume of the whole mixture before undergoing reaction. When produced in this manner, the precipitate is granular and may be filtered with great rapidity. About 85 per cent. of the levulose from the artichoke juices is recovered in the levulate cake, from which after carbonatation in the usual manner a nearly water-white syrup is obtained of about 94 per cent. purity. Massecuites which yielded white sugar are obtained from the original white liquors and from the mother-liquors of 80-85° purity; whilst from the molasses of 69° purity a raw sugar can be crystallized after a period of several weeks, the final molasses being again submitted to the levulate process. From 80-85 per cent. of the levulose in the crude liquors can be recovered as crystalline sugar.

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[1] *I.S.J.*, 1923, 41.

Carbonatation *versus* Sulphitation in the Manufacture of White Sugar in Natal.[1]

By L. E. ROUILLARD,
La Mercy Estate, Natal.

SULPHITATION.

Working according to the principle that a bulky precipitate tends to remove more impurities from the juice than a light one, we conducted at La Mercy factory a number of experiments to ascertain, if possible, the limit up to which sulphitation could be carried to obtain a high-grade sugar. The juice was sulphured with from 1 to 4 grms. of sulphurous acid per litre, adding naturally an equivalent proportion of lime to reduce its acidity. Owing to the difficulty experienced with such a heavy sulphitation, recourse was had to a double sulphitation process by which the juice was limed and sulphured and subsequently pumped through a second sulphitation column, being ultimately partly neutralized with lime. Subsidation under this treatment left nothing to be desired, and filtration was comparatively good, although the scums were more or less slimy.

All these processes, however, never produced what could be called a first-rate white sugar. It was certainly of good quality, but did not fetch the best market price. It must be remembered that the South African market is hard to please, as sugar must come close to the refined product in order to attract buyers. Having failed to obtain the principal object in view, it was naturally concluded that the relatively large precipitate was not sufficiently bulky to remove all the colouring matter from the juice, and that the bleaching action of the sulphurous acid was too fugitive to be reliable, whatever might be the initial quantity of the gas used. However, the process was continued, and in addition the syrup was sulphured. Although the sugar produced was certainly of better quality than before, it could not stand comparison with our best samples obtained with sulphitation in conjunction with phosphoric acid.

It is certainly true that in theory sulphitation should not be carried out beyond the neutral stage, but up to now no one, in this country, to my knowledge, has ever produced a superior white sugar who did not work the juice freely acid. The trouble experienced with calcium bi-sulphite under these conditions is extremely worrying but is one of the things which the manufacturer of white sugar must accept as an unavoidable expense.

In spite of these unfavourable results, it would be rash positively to declare that the best mill-white sugar cannot be secured by sulphitation alone, and I am rather inclined to believe that the best manner of applying sulphurous acid has still to be found. It must be remembered that these experiments on a large scale are costly when not successful, and can only be carried out for brief periods. For this reason, I have always thought that a small experimental factory would result in the solving of important problems, and would have amply paid the industry long ago had it been established.

CARBONATATION.

If we turn our attention for a moment to the carbonatation process (which has given such gratifying results to the directors of The Natal Estates) it is at once evident that the extremely large quantity of lime used, which is converted to calcium carbonate by the addition of carbonic acid gas, envelops the colouring matter, gums and so on that are ultimately and completely removed by filtration in bulk. This is the best proof we have that the purification of the juice is only to a certain extent a chemical reaction and is after all mainly a physical action. It cannot be supposed that such a large quantity of lime is required to form a chemical combination with the relatively minute proportion of colloidal substances in the juice. Their separation must be attributed to their physical inclusion in the dense precipitate, which is easily separated from the pure juice, avoiding thereby all the trouble experienced with the sulphitation process at the last stage.

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[1] Extracted from a paper read before the Congress of the South African Sugar Industry, Durban, 1924; *S. A. Sugar Journal*, 1924, 93-96.

USE OF PHOSPHORIC ACID.

Seeing that the granular precipitate of calcium sulphite is not sufficient to secure the elimination of certain chromogenes, the use of phosphoric acid has been more or less universally adopted as an addition to sulphitation; and the voluminous precipitate produced by the combination of lime with phosphoric acid separates most if not all the colouring matter, which remains in the mud or filtration. Were it not a question of cost, I am inclined to believe that good results would follow from filtration in bulk with sufficient phosphoric acid to secure free filtration.

Having always in view the necessity of improving our recovery we decided a couple of years ago to work according to the process recommended by **MULLER**[1] according to whom certain canes yield a juice which does not settle properly on account of the presence of what he calls colloidal organo-silicious compounds. He claims that by heating raw juice to 116°C (240°F.) with subsequent cooling to 45°C. (115°F.) before sulphuring and liming, these products are completely decomposed. The silica combines with the lime and is precipitated, the organic matter coagulates, and the colloidal substances are destroyed by superheating. A third of the lime ordinarily used is sufficient to obtain perfect settling, and sulphitation may even be dispensed with. Besides, the complete elimination of the gums reduces almost completely the viscosity of the final products.

Clearly this seemed to be all that could be desired for our refractory Uba juice. But I am sorry to say the experiment was negative, and had to be stopped almost immediately because of the losses produced by inversion on account of the high temperature which with the means at our disposal could not subsequently be rapidly reduced. After heating the juice to 116°C. (240°F.) it was found that the installation which had been erected at a small expense was not sufficient to cool the juice to the required extent, viz.: 45°C. (115°F.), and on account of the difficulty of improving our conditions we reluctantly gave up the experiment.

I mention these details because during the time we actually tried the process subsidation was almost immediately perfect, and filtration through the presses the best I ever obtained. Except in the case of old burnt cane containing acetic acid, the process is certainly worth trying for those who have an excess of fuel and a relatively large supply of water.

CONCLUSIONS.

(1) Judging from our results, simple neutralization of juice by lime (the defecation process) has comparatively no effect on the gums, and leads to the formation of extremely viscous final products which cannot be properly cured.

(2) Moderate sulphitation produces a better juice, but the gums are not sufficiently removed to secure the highest possible recovery.

(3) The most liberal sulphitation does not seem to clarify the juice to the extent necessary for the production of the best white sugar.

(4) Phosphoric acid appears materially to help the removal of certain coloring matter in the juice.

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[1] *I.S.J.*, 1921, 579.

(5) The great advantage of the carbonatation process over sulphitation is the complete removal of all objectionable impurities by filtration at the initial stage, leaving extremely fluid after-products which do not require any further treatment.

Discussion.

Mr. **Dymond** stated that he had spent a few days at Mount Edgecombe where the action of lime on the juice at a temperature of about 50°C. seemed to be one of the main features. He had found that by liming the third and fourth mill-juices at a temperature between 45 and 50°C. he had obtained a distinct rise of 2 to 3° purity between the mixed juices and the clear juices, a rise which they did not obtain before.

Mr. **Rouillard** explained that in Java they always heated the juices up to 50°C. before liming, and had found very favourable results. He had done it also, and had found a great difference in filtration, compared with working the cold juice.

Mr. B. **Pearce** stated that he had the opportunity whilst in Hawaii of seeing an experiment on liming the fourth and fifth juices. Lime was added to the fourth mill juice, returned before the third, and then before the second mill. The increase in the total recovery was raised from 87·67 when the juice was carried neutral to 92·60 when the juice was alkaline; and the undetermined losses were reduced from 4·19 per cent. to 0·70 per cent.

Mr. **Rouillard** stated that when he came to this country about 25 years ago they had what was known as "gummy disease." He was told by one of the old planters that it was impossible to cook the sugar, and that it would not crystallize. Finally he added a large quantity of lime before sulphuring, and managed to make sugar where he could not before.

American Commerce Reports.[1]

The Sugar Machinery Market in Java.

One of the most important industries in the Dutch East Indies is the production of sugar; but so far American manufacturers have not been very successful in supplying the needed machinery equipment. Vice-Consul Rollin R. Winslow, of Soerabaya, Java, has been collecting data on the purchasing methods of sugar mills in his district which explain in part the failure of American manufacturers to participate in this business. Mr. Winslow states that it is useless for American manufacturers to expect to secure business merely by sending catalogues and printed matter to the sugar mills. The reason for this is that important purchases are usually made either from head offices of the sugar companies in Holland or through branch offices located in the principal cities of the islands. The plant managers are ordinarily without authority to purchase machinery, so that the practice of circularizing the mills with catalogues is worthless as a selling method. Nearly one-half the sugar mills control all purchases through head offices in Holland.

The problem of selling machinery in the Dutch East Indies is one of proper representation in the country. About 35 per cent. of the mills purchase machinery equipment from agents of European firms located in Java Roughly 40 per cent. of the mills are managed directly by the owners, the remainder being managed by firms which specialize in that business. It appears to be a fixed rule in the sugar industry that purchases in Java are made only from the agents of manufacturers who have established offices and carry stocks locally. If an agency is established with a concern which enjoys a good reputation, credit terms, consistent with good business methods, deserve consideration. This would serve to meet, in part, active competition from European sources, a factor of which is the liberal extension of credit terms.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

British, German, and French import houses are active in the market. The lack of established agencies or branch offices managed by Americans for American interests is given as one of the principal reasons why the share of the United States in the machinery trade of the Dutch East Indies is not greater than potentialities indicate.

Dominican Republic.

General.—The 1923 sugar crop, originally estimated at 234,000 short tons, amounted to only 206,272, owing to insufficient rainfall to develop the cane to its usual standard. However, nearly all mills completed operations in about four months, thus bringing production costs down to a very satisfactory level and this fact, together with reasonably good market conditions, combined to make the 1923 crop a medium success and materially improve the condition of the sugar industry, by enabling many mills to liquidate outstanding credits. All the sugar not needed for domestic comsumption (about 8000 short tons) was exported, and the prospects of a larger and more profitable crop for 1924 are very good. The various mills have no difficulty in obtaining the credits required for operating requirements.

La Romana District.—The Central Romana (Inc.), doubtless the largest sugar development in the Dominican Republic, has been exporting sugar cane during the past 10 years in addition to its manufacturing operations. All sugar cane shipped is sent by steamer to the port of Guanica, P. R., and sold to the South Porto Rico Sugar Co.

During 1923 the Central Romana (Inc) had under charter for a period of approximately four months an American steamship which was engaged in carrying sugar cane and passengers to Porto Rico. The Central Romana exported 74,841 tons of cane during 1923 and has had two American steamers under charter since January, 1924, both steamers having transported approximately 110,000 tons of cane.

Practically all of the raw sugar is shipped to Canada and Europe, while the granulated sugar is manufactured for local consumption. While there has not been a very substantial increase in production during 1923 as compared with 1922, the year 1924 should show a greater increase in cane production, most of which will be shipped; approximately the same amount of cane will be ground and manufactured.

San Pedro de Macoris District.—Agriculture has been and will remain for many years the most important source of wealth in this territory. Sugar is the principal product. During the year 1923, 97,390 tons of sugar (raw) were manufactured by the seven sugar plants located in this Province, and with an average price of $4 per 100 lbs. f o.b. Macoris having been obtained, 1923 was a profitable year for sugar producers. The price was not as high as that during the war, although the cost of production was materially lowered. The average cost of production of 100 lbs. of sugar during 1923 is believed to have been about $1·90 f.o.b, Macoris. There were exported to the United States 54,508,077 lbs. of sugar, valued at $2,826,815, in 1923.

The general expectation is that conditions in 1924 will be better for sugar producers than 1923, as a better market price is anticipated. Sugar production for next year is estimated at 130,000 tons, or 30,000 tons above the production of this year.

Hong Kong.

There was considerable fluctuation in the prices of raw sugar in 1923, owing to speculation and to the uncertainty regarding international supplies. The movement of prices largely followed the Java and American markets. In the autumn there was a gradual improvement in prices, which was maintained to the end of the year.

Imports amounted to 26,000 tons, slightly below the figure of the previous year. Of this amount, 80 per cent. was imported from Java, and the remainder from the Philippines, Cuba, and South America. About 30 per cent. of the import total was re-exported to China and Japan.

The continual fluctuation of the price of sugar had a restraining influence on the local sugar refining industry during 1923. Approximately 40,600 tons of raw sugar were received, of which about 85 per cent. came from the Dutch East Indies. Approximately 70 per cent. of the amount imported was refined locally and sold in the Chinese markets.

Publications Received.

Saturation Relations in Mixtures of Sucrose, Dextrose, and Levulose. R. F. Jackson and Clara Gillis Silsbee. Technologic Paper No. 259; Bureau of Standards; Department of Commerce. (Government Printing Office, Washington, D.C., U.S.A.) 1924. Price: 10 cents.

It is of course well recognized among those connected with the production of table syrup that there is at each temperature a ratio of sucrose to invert sugar at which the concentration of total sugar attains a maximum without the deposition of grain (so-called "granulation"). The determination of this maximum solubility being of considerable practical importance, the authors have studied syrups containing sucrose, dextrose and levulose as phase rule systems, and have recorded the solubility of each in the presence of the other in this Bulletin. Their results are of much interest, and the solubility data obtained are certain to be of value to the sugar industry.

Producers of table syrup, e.g., "Golden Syrup," would without doubt welcome a method of predicting from the solubility curves of the three sugars concerned the probability of the granulation of their product. But in this Bulletin, apart from several difficulties (manipulative, technical, and analytical) which beset an investigation of this kind, together with certain approximations, which (in the authors' words "cannot be considered data of high accuracy"), it would seem that insufficient regard is paid to the effect exerted by the mineral and organic matter present in commercial syrups. That this effect is an important one, by no means to be neglected in any investigation of the problem, is naturally well appreciated by those who have studied it. It is in our view a problem which is complicated by several factors, and which depends largely on knowledge and experience of those conditions under which factory-made syrup is produced and marketed. It would, in fact, be hazardous to deduce from the results of experiments made with pure materials under laboratory conditions what the composition of a commercial syrup must be to resist granulation under totally different conditions. In Table 9 (page 298) figures are given for the composition of solutions of maximum solubility at various temperatures, these being based on one test made at 30°C., the other values being computed. In an average table syrup the percentage of water is say from 17 to 20. Looking at the paragraph following the table mentioned, one reads that "if the manufacturer wishes to prepare his syrup with the maximum density, he should adjust the solution to contain the proportions of sucrose, invert sugar, and water for the temperature at which the product is expected to be maintained." In this country the temperature at which such a syrup would probably be used is 15°C.. and the figures for this temperature read from the table are: Sucrose, 39·1; invert sugar, 34·8; and water, 26·10 per cent. But a syrup made with this water content would obviously be too thin in gravity for market requirements; whilst experience with "Golden Syrup" teaches us that with the proportions of sucrose and invert sugar stated, calculated on a basis of 17-20 per cent. of water, the product could not be considered safe.

The Manufacture of Confectionery. Robert Whymper. Pp. viii + 251. (The St. Catherine Press, London) 1924. Price: 25s, net.

One is often called upon to recommend "a reliable book on confectionery manufacture," and of the several publications on the subject (mostly mere collections of recipes, many difficult to follow accurately) the only one that can be named without hesitation is that by Jacoutot. Yet this work is by no means a scientific one, procedure being purely empirical throughout. Mr. Whymper, a chemist, in the book before us has based his writing on the successful methods of Jacoutot, but in his revision of this author's book he has made an attempt towards introducing scientific principles by giving in a preliminary chapter a discussion of the principles involved in the art of confectionery making. This is a step in the right direction, though, it may be added, the discussion is a short one and methods of chemical control do not enter into the manufacturing methods described. In the main the book consists of: (*1*) a description of the machinery used (made mostly by Baker, Sons & Perkins), and (*2*) a collection of recipes for manufacturing a wide variety of confectionery goods, as well as jam, jelly, fruit pastes, preserved fruits, and the like. His descriptions of machinery where given are quite clear, and provide the confectioner with an outline of this branch of his knowledge of the subject. In regard to the recipes, these consist largely of the original formulæ given in the first edition of the French work, which experience has shown are in general superior to those found elsewhere; but these have been supplemented by others of tried worth.

Die gefahrlose neuzeitliche Zuckermüllerei [Modern Sugar Crushing without Danger of Explosion]. By P. Beyersdorfer and W. H. Geck. (Published by W. H. Geck, Worms, Germany). 1924. Price: 3s. (paper covers).

In this booklet dealing with plant for the crushing and grinding of sugar without danger, Dr. BEYERSDORFER deals with the theoretical aspect of the problem on the same lines as those developed in his interesting articles, summarized recently in our columns.[1] Then Mr. GECK discusses the following matters from the practical side: buildings, grinding machines, conveying and storing the ground sugar, explosion and fire risks, and commercial aspects. Lastly, a series of photographic illustrations are given, two showing the great wreckage which may be caused by a sugar dust explosion, and others depict the arrangement of plant and buildings approved by these authors.

The Woburn Experimental Farm and its Work (1876-1921). By J. Augustus Voelcker, M.A., B. Sc., Ph. D. (Royal Agricultural Society of England, London). 1924. (Author's Reprint).

In a comparison of mangels and sugar beet in 1911, the former gave 44 tons 4 cwt. per acre of roots (uncleaned) against 23 tons 15 cwt. (unwashed) of the latter. On washing the roots it was found that the mangels lost 13 per cent. of their weight, and the beet about 35 per cent. An estimate was made that year of the relative cost of growing the two crops, and it was reckoned that the beet cost £2 an acre more to grow than the mangels. Another trial on these lines in 1912 gave similar losses in washing (13 per cent. and 30 per cent.). "Klein Wanzleben Z" was found to give a better yield than either "Vilmorin's Improved White" or "Klein Wanzleben N." An item of general interest in Dr. Voelcker's report concerns the inoculation of crops. He has examined the possible value in the case of different crops of Nobbe's "Nitragin" at Woburn, in 1896, of Hiltner and Moore's methods in 1905; and of Bottomley's "Humogen" more recently.[2] But the general result of all these experiments was to prove that no increased nitrifying action was set up by the inoculation process, either in pot culture tests or in field work, and the net conclusion is that "none of the inoculating methods put forward possesses any claim to practical value."

Die Schokoladen-Fabrikation [Chocolate Manufacture]. Dr. Paul Zipperer; revised by Dr. Herm. Schaeffer and Dip.-Ing. Schröder. With 95 illustrations. (Verlag von M. Krayn, Berlin, W.) 1924. Price: $5.

This is a comprehensive work on the manufacture of chocolate and cocoa and their preparations. It treats of the agriculture of the cocoa plant, its varieties, and its harvesting; the manufacture of cocoa products; substances addded in chocolate manufacture; the examination and evaluation of cocoa preparations and the raw materials used; and, lastly, a list of trade preparations with particulars of their composition, where known. It contains a good number of illustrations, mostly of German machinery employed in this branch of industry.

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[1] *I.S.J.*, 1922, 573; 1923, 412, 551. Also, JAECKEL, 1923, 363.

[2] *I.S.J.*, 1914, 238; 1915, 96; 1916, 222; 1917, 284; 1920. 54.

Tests on Volumetric Glassware. (National Physical Laboratory, Metrology Department, Teddington, Middlesex, England) 1924.

Class A (vessels intended to possess the highest accuracy) and Class B (for those possessing only "commercial accuracy") are distinguished in these regulations governing their testing. The millilitre[1], the one-thousandth part of a litre, is the unit now accepted by the N.P.L., in place of the c.c., and the relation between the two is: 1000 ml. = 1000·027 c.c. The tolerances specified in the case of some of the apparatus used in the sugar laboratory for Classes A and B respectively are as follows: 100 ml. flasks (for content, not delivery), 0·06, 0·10; 1000 ml. flasks (content only), 0·2, 0·4; 50 ml. pipettes, 0·04, 0·08; 50 ml. burettes, 0·06, 0·10; 10 ml. graduated pipettes, 0·06, 0·06; and 100 ml. graduated cylinders, 0·4, 0·8.

Das Kalkbrennen [Lime Burning]. Berthold Block. Second enlarged Edition, with 270 illustrations in the text. (Otto Spamer, Leipzig, Germany) 1924. Price: 27.5 Gold marks (bound).

This is the second edition of a very comprehensive work on Lime Burning and the Production of Carbon Dioxide, published in 1916[2]. It is probably the most complete yet published on the subject, and discusses in a thorough manner from both the theoretical and practical standpoints most phases of the subject. This new edition retains the form of its predecessor, whilst incorporating an amount of new matter.

Trade Notices.

New Literature on Filtration. Bulletins F-41A, F-43B, F-44, and F-45. (Celite Products Co., of Chicago, Ill., U.S.A.) 1924. Free on application.

These bulletins on the use of "Filter-Cel" in the clarification of cane and beet sugar liquors and syrups, and re-melt liquors, are of considerable interest to sugar technologists concerned with the filtration of their various products, and demonstrate the great value of this filter-aid. Bulletin F-44 gives a series of typical show charts, covering the various steps in the process of manufacturing cane and beet sugar, corn products, dyes, cereal beverages, fruit products, oils, and many other products. These flow charts follow through from raw material to finished product, and indicate the exact point in the process where filtration is accomplished and the most economical percentages of "Filter-Cel" to employ in each case, based on the factors of desired clarity, length of filtration cycle, and rate of flow. Several new bulletins have also just been published by Celite Products Co., covering "Sil-O-Cel" Insulating Brick for the insulation of boilers and other heated equipment.

Centrifugal Machines for Separation and Decantation. (Watson, Laidlaw & Co., Ltd., 98, Dundas Street, South, Glasgow.) · 1924. Free on application.

Centrifugal machines, for use in the clarification of liquids, having drums with imperforate shells upon which the heavier constituents are deposited, are described in this pamphlet. Illustrations are given of centrifugals specially designed for this class of work ranging from laboratory machines to installations of a much larger type for factory use. For example, the "Victoria" testing machine is a laboratory centrifuge, having provision for 12 test-tubes, and being capable of operation at 10,000 revs. per min. Illustration 3116 is a machine for industrial use in separating two liquids of different gravities, or for the clarification of a liquid containing a very small percentage of solid. This type was originally designed for separating cream from milk, and is hand or belt-driven. Illustrations 5391 and 5392 show 40 and 30 in. machines, water-driven, for separating liquids of different gravities, the latter being for special work demanding running at a very high speed. And illustrations 5395 and 5394 depict batteries of 4 and 12 machines for the same purpose as the last mentioned. Those interested in centrifugal clarification should be in possession of this pamphlet, which is obtainable on application.

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[1] *I.S.J.*, 1924, 555. [2] *I.S.J.*, 1921, 527.

Brevities.

As the result of extensive field trials in Argentina with a good number of cane varieties, Dr. Wm. E. Cross decides[1] that P.O.J. 2725 is the best, in respect of good yield of cane and sugar, immunity to mosaic, easy trashing and transport, and general characteristics as a thick cane. Its yield is about three tons of sugar per hectare as plant, and 2·4 as first ratoon.

The Colonial Office Report on Jamaica for the year 1923 remarks that the sugar industry in that island has found itself in the tantalizing position of having a splendid market for its sugar and latterly a better demand for rum, only to find its production seriously curtailed by three years of drought. The estates in Vere have suffered most severely, despite great efforts to deal effectively with the inadequate supplies of water available for irrigation.

Urea, made in Germany on a large scale, is being offered as a nitrogenous fertilizer in different countries. But C. H. van Harreveld,[2] in a series of comparative percolation tests found that, whereas not more than 2 per cent of ammonium sulphate and 3 per cent. of ammonium chloride was washed out, on the other hand with urea not less than 76-99 per cent. was lost by leaching.

The Association of British Chambers of Commerce has issued the following declaration: "That in order to obviate difficulties which now arise from the difference between the Imperial and American gallon,[3] and also to promote uniformity of practice throughout the world, this Association is of opinion that it is desirable that all traders, especially those engaged in overseas trade, should employ some universally accepted measure, such as the litre, the use of which is already permitted by law, as the sole unit of capacity."

Continuous evaporation, boiling, and crystallization is said by M. D. Ziew[4] to be possible practically in sugar manufacture. Regarding the construction of the plant used by him, he only mentions that it consists of a vertical, cylindrical evaporator connected below with a crystallizer through a wide pipe, which can be opened or closed. Clarified juice is continuously fed into the evaporator so that it remains above the syrup already present, and is successively converted into syrup and massecuite, the latter being transferred at intervals into the crystallizers beneath.

Much interest has been aroused in engineering circles in the steam accumulator invented and patented by Dr. Johannes Ruths, of Stockholm (who delivered a paper on the subject at the recent World Power Conference at Wembley Exhibition, London). He has adopted the principle of the accumulation of steam in water on entirely different and more important lines than hitherto attempted, making its operation an essential part of the steam plant, so as to revolutionize the generation of steam in the boiler. From the point of view of the average chemical works, the advantage is that the boiler plant can be kept running at a steady steam output and pressure all the time, whilst the steam is being stored into the accumulator and delivered as required. For example in a factory demanding steam fluctuations over wide limits it may be necessary to employ five boilers, whereas with a steady demand three might suffice. This difficulty, it is claimed, can now be overcome by the installation of a Ruths accumulator; though, if complete success is to be attained, the storage capacity must be a large one, viz., when 25,000 to 70,000 lbs. of steam are already in operation.

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[1] *Rev. Ind Agr. Tucuman*, 1923, 24, 14. 89-108.

[2] *Archief*, 1924, 32, No. 8, 261-267.

[3] The British Imperial gallon is 4·55 litres and the United States liquid gallon only 3·78 litres—a difference which leads to endless confusion and loss. Because of this 20 per cent. disparity, the United States liquid gallon is not legal for use in Canada. The litre (or so-called "world quart") is the only liquid measure that is uniform throughout the Americas; and it is legal in the United States, Canada, Mexico, Central and South America, as well as on the European Continent. Petroleum corporations (British, American and Mexican) are considering the adoption of the "world standard gallon," consisting of 4 litres, the legislation of which would be of immense convenience to those connected with the industry—producers, marketers, and consumers alike.

[4] *Centr. Zuckerind.*, 1924, 32, 603-604.

The Cuban Government has appointed a representative of the Department of Agriculture to visit Germany and prepare a report on German agricultural implements with reference to their adaptability for use in Cuba. Special attention will be paid to implements designed for use in restoring fertility to exhausted soils

In summarizing the average technical data for Moravian factories for 1923-24, **Ales Lansbauer**[1] gives a number of interesting figures, the most important of which are as follows: Roots sliced daily, 8·2 quintals; diffusion draw-off, 111 per cent. roots; total lime added in carbonatation, 2·4 per cent roots; raw sugar produced 17·48 per cent. roots; molasses produced, 1·20 per cent. roots; coke consumption, 0·54 per cent roots; average coal consumption, 7·3 per cent. roots, but in factories using pressure evaporation the coal consumption was from 5·2 to 5·5 per cent. on the roots, a notable reduction. Hands employed per 1000 quintals of roots, 50.

J. A. **Kucharenko**[2] recently discussed the possibility of obtaining crystals of uniform size during the boiling of the massecuite, but points out that under present conditions this is impossible. The period during which crystal formation takes place may be from 10 to 20 mins., and the result is that crystals of different ages are always present in the strike, the rate of growth of these immediately after formation being very rapid, though later it diminishes. Theoretically, therefore, crystallization should occur simultaneously, and to realize this the point of supersaturation must be reached simultaneously throughout the strike, and at the same time a sufficiently large number of crystals must be formed. A large heating surface and a high temperature difference must be used for attaining the first condition; but, as to the second, insufficient is known of the mechanism of the formation of crystals in the vacuum pan for the expression of a definite opinion regarding the necessary factors.

Émile Saillard explains his method of estimating the French crop of beet sugar from the sugar content of the roots[3] He determines the amount of sugar in the field per hectare for the last week in September, and multiplies this by the factor 0·588 (which itself is the product of two factors, viz., 0 76, that for the yield in the field, and 0·774, that for the rendement in the factory). This gives the production or sugar per hectare, and when multiplied by the total hectarage gives the estimated crop in terms of refined sugar. Thus, for 1924-25, the average sugar found per hectare is 5·9 tons, which multiplied by 0 588 gives 3·469 tons of sugar per hectare and this multiplied by 196, 615 hectares (the area planted) gives 678,588 tons as the estimated crop for the present campaign in terms of refined sugar. This method of estimating gives results always higher than actually obtained, but these are reasonably close as predictions The factors used are based on values observed during the years 1904 to 1913. If the result is to be calculated as raw sugar, the factor 0·653 is used in place of 0·588.

Complaint is made by **Percy May**[4] that "ability to write grammatical English does not seem to be a necessary qualification for a patent agent. Patents taken out by foreigners frequently appear to be mistranslated into English in the most clumsy fashion in such a way that the resulting sentences have no clear meaning. . . . . . As the Patent Office employs a large staff of examiners, it seems a pity that a reasonable standard of clarity in language and freedom from error in technical terms is not enforced before a patent is granted." Most of those who have occasion to pursue patent specifications will agree that frequently this indictment is well deserved, and is by no means confined to foreign applications, although, in general, it certainly is not applicable. At times one encounters specifications in which abound faulty construction of sentences, grammatical inaccuracies, tautology, verbosity, and the like, as well as vagueness and ambiguity (which latter two faults are in some cases probably not unintentional on the part of the patentee). And we agree with **Mr. May** that the Patent Office examiners should not overlook defects of this nature in the applications published by them.

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[1] *Zeitschrift für die Zuckerindustrie der Czecho-slovakischen Republik*, 1924, **48**, No. 43, 359-365.

[2] *Zeitsch. Zuckerind. Czecho-Slov.*, 1924, **48**, No. 41, 332.

[3] *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France*, No. 1852, of 1924.

[4] *Chemistry and Industry*, 1924, **43**, No. 40, 987.

Review of Current Technical Literature.[1]

FILTRATION IN THE BEET SUGAR INDUSTRY [KELLY, VALLEZ, SWEETLAND, AND "AMERICAN" FILTERS, DORR AND OLIVER-BORDEN, THICKENERS]. *Joseph Maudru.*[2] *Facts about Sugar, 1924, 19, No. 13, 304-307.*

In beet factories in the U.S., the juices and syrups are subjected after carbonatation, sulphitation, and evaporation to no less than five successive filtering operations. But the most important is that after carbonatation, when a slurry, equivalent in its total weight to 150 per cent. of the weight of the beets, and containing about 3 to 4 per cent. of insoluble solids, has to be dealt with. Although various attempts to replace the plate-and-frame equipment have been made, these have not been definitely and generally successful Some recent developments have advantages, though usually at the expense of some desirable feature ; and beet sugar manufacturers still wait for a filter simultaneously combining low costs in respect of : maintenance, labour, cloth, and sugar loss. Nevertheless, some of these developments are promising, and their salients points are here summarized as follows. *Kelly filter.*—It compares most favourably with the plate-and-frame press in the items of labour and cloth, and in the fact that it has only one joint to maintain, but somewhat unfavourably in the item of wash-water required and values left in the cake. *Vallez filter.*—When cloth is used, difficulty is experienced (according to the author's experience) with ruptures and the detection of the defective cloth, whilst cloth renewal is tedious. These filters were abandoned for carbonatation work in the author's tests, but, equipped with monel metal "cloth," they were used for hot saccharate (which requires the renewal of the fabric cloth every 24 hours), in which service it proved to be "a fairly good filter." *Sweetland filter.*—This type has the advantage over the Kelly in having less occupied volume to produce "excesses," and over the Vallez in that cloudy leaves are more easily detected, removed, and replaced. But all three filters have the common objection of being intermittent in operation, which necessarily adversely influences the cost both of installation and working. To-day the best thought tends towards the use of a thickener, the concentrated sludge being handled with a rotary vacuum filter, which combination of apparatus seems to answer as fully as is possible at present the requirements of labour, cloth, and sugar loss. *Dorr thickener and vacuum rotary filter.*—At first sight this combination presents promising possibilities, but experience showed that the character of the precipitate was such that it would not deliver a bright overflow (even when operated at a comparatively low alkalinity). Therefore, the idea was abandoned, so far as the author is concerned. *Kelly filter and vacuum rotary filter.*—This combination (using the Kelly filter as a thickener by dropping its cake, and repulping it) has been in successful operation for four years, showing considerable advantage in several directions, viz , labour, cloth, and sugar loss, though the factor of sq. ft. of filtering area is rather high per unit of output. *Oliver-Borden thickener and rotary vacuum filter.*—Labour, cloth, and sugar loss all appear low, whilst its capacity is about 0·98 ton beet per 24 hours per sq. ft. of filter area. "*American*" *filter.*—This type is on the same principle as the Oliver and Portland, except that instead of having a cylindrical drum divided into compartments to carry the filtering medium, there are a number of vertical discs on a rotating shaft to carry the cloth. It has been tried on cold saccharate, but only with limited success.

ACTION OF SULPHURIC ACID ON THE AMINO-ACIDS PRESENT IN BEET MOLASSES AND BEET VINASSE FOR THE PRODUCTION OF AMMONIUM SULPHATE. *P. G. Kronacker.* *Bull. Soc. Chim. Belg., 1924, 33, 217-231.*

Glycine, asparagine, aspartic acid, glutamic acid, leucine, and the vinasse (spent wash) from beet molasses gave quantitative yields of ammonium sulphate when treated with sulphuric acid (66 per cent. concentration) ; but betaine, tryptophan, and arginine require to be broken down into simpler substances before they can be decomposed by this treatment.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Great Western Sugar Co , Denver, Colo., U.S.A.

QUESTION OF THE PRESENCE OF ARSENIC IN BEET MOLASSES. *C. Bruhns.*
Centralblatt für die Zuckerindustrie, 1924, 32, No. 46, 948-949.

Dr. LÜHRIG, Chief of the Municipal Chemical Examination Bureau of Breslau, recently published[1] a communication on potassium carbonate which contained arsenic. He stated that after a meal in which ginger-bread cakes had been eaten, members of a family partaking of them had fallen ill, exhibiting symptoms of poisoning, and that examination of the ingredients had shown arsenic to be present in no inconsiderable amount in the potassium carbonate which had been used (presumably in the baking powder), namely, as much as 0 10 to 0·16 per cent. as As_2O_3. If 10 grms. of the potassium carbonate had been added per lb. of meal, then there must have been present in the cakes about 10 mgrms. of As_2O_3, whereas according to the German Pharmacopeia 5 mgrms. is specified as the highest single dose that may be administered. Further, it was suggested that possibly potash produced from molasses might have been employed in making the cakes, though it was not certain that this was so. Dr. BRUHNS therefore discusses the possibility of contamination from this source, mentioning first of all that anyway the amount of molasses potash on the market must be quite a minor quantity. It is true that soils contain arsenic in small quantity, that insecticides containing it may have been used in the cultivation of the beets, that it is known to be present in coal, that it may have been introduced into the juices through the lime and carbonic acid used in clarification; but that even if a certain amount had thus found its way into manufacture it would have been precipitated in the carbonatation in the form of its insoluble calcium salts; consequently it is very improbable that arsenic could find its way into the molasses so as to give rise to the presence of the amount mentioned above in the potassium carbonate produced from it. Then another reason why the presence of arsenic in molasses in any amount is extremely unlikely is that the carbonized mass contains only 30-35 per cent. of potassium carbonate, while calcium salts are also present, calcium arsenate and arsenite both being insoluble in water and in alkali carbonate solutions. His method of identifying the presence of arsenic in molasses is to mix 100 grms. with a good proportion of calcium hydroxide, or of powdered slaked lime, to carefully ash the whole, to dissolve the residue in HCl, to dilute with water, and to pass H_2S into the liquid, when the "smallest traces" would be indicated by a yellow precipitate.[2] Any other metals present are separated by washing on a filter with a little ammonium carbonate solution (returning this 15-20 times), and acidifying the filtrate, when yellow flocks of arsenious sulphide would appear in the presence of this metal.

DETERMINATION OF SUCROSE AND REDUCING SUGARS IN PLANT EXTRACTS COLORIMETRICALLY, USING THE PICRIC ACID METHOD.[3] *W. Thomas and R. A. Dutcher.*
Journal of the American Chemical Society, 1924, 46, 1662-1669.

This modification of the method of BENEDICT and OSTERBERG[4] is claimed to be superior to the gravimetric process for the determination of small amounts of sucrose and reducing sugars in plant extracts, and is carried out as follows: An aliquot portion of the extract (obtained by alcohol with the powdered sample in a Soxhlet apparatus), containing 0·025 to 0·150 grm. of reducing sugars is evaporated *in vacuo* to remove the solvent, and the residue washed into a 400 c.c. beaker with 100 c.c. of water, a slight excess of mercuric nitrate reagent[1] being added, then sodium bicarbonate, till frothing ceases and the liquid is alkaline to litmus. After rapidly filtering, the precipitate is washed with 5 per cent. sodium bicarbonate solution, and the filtrate and washings made up to 250 c.c. Now 30 to 50 c.c. of this solution contained in a 75 c.c. test-tube are treated with 0·3 to 0·5 grm. of zinc dust and one drop of HCl to remove the last traces of mercury. The tube is shaken; and, after standing for 15 min., the liquid is filtered through a hardened filter-paper. Into a "Pyrex" test-tube are placed 5 to 10 c.c. of the filtrate, and 10 c.c. of picrate-picric acid solution,[2] followed by 2 c.c. of 25 per cent. sodium carbonate solution, the volume being made up to 22 c.c. with water, if necessary, and the tube immersed in a water-bath at 95° C. for 20 min. A parallel test is made with a tube containing 10 c.c. of standard dextrose solution, 10 c.c. of picrate-picric acid solution, and 2 c.c. of 25 per cent. sodium carbonate solution, heating being carried out under the same conditions, and the two tubes after cooling compared in a colorimeter, suitably diluting. In determining the sucrose, inversion is effected by following the procedure of the Herzfeld double polarization method, the resulting increase of colour compared with the liquid previous to inversion being a measure of the disaccharide present.

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[1] *Chemiker Zeitung*, 1924, No. 81.

[2] This test is unsuitable for indicating the "smallest traces." A much more delicate one is the modification of the Marsh-Berzelius process, as recommended by a Joint Committee of the Society of Public Analysts and of the Society of Chemical Industry in 1902. This Committee was convened as the result of the alarm occasioned by the arsenical poisoning of beer in the United Kingdom in 1900-01, and now in this country the testing of beer and of brewing materials, as well as of a number of food-stuffs, has become a matter of routine. Under the Food and Drugs Act, the limit of safety for the presence of arsenic in foods is 1/100th of a grain per lb., and Public Analysts usually prosecute when they find more than that amount, this Act being based on the observation that arsenic is accumulative in its effect, and the belief that the constant use of food of various kinds contaminated with this impurity might eventually prove disastrous. The reports, minutes of evidence, and appendices on the Royal Commission of Arsenic Poisoning, 1902, may be regarded as a standard text-book on the subject, and is recommended to the notice of those interested. (The First Report of the Committee, and the First Volume of Evidence published in 1904, are still available at H.M. Stationery Office, London, W.C.2; price 3s 11d.; but the Final Report, and the Second Volume of Evidence, are out of print.)—ED., *I.S.J.*

[3] A somewhat similar method was quite recently described by COE and BIDWELL, for which see *I.S.J.*, 1924, 279.

[4] *Journal of Biological Chemistry*, 1918, 34, 195.

Determination of Reducing Sugars by the Picric Acid Method. ***J. J. Willaman and F. R. Davison.*** *Journal of Agricultural Research, 1924, 28, No. 4, 479-488.*

A search for a reasonably permanent colour standard for use with the picric acid method for sugars[3] has been unsuccessful; but the best standard is either an 0·08 per cent. glucose solution, or an 0·076 per cent. sucrose solution, in saturated picric acid, which will keep for about a week, or these same solutions in water in which case they must be used at once. Other points determined by the authors are: Heating glucose in a solution of picric acid previous to reduction in a sodium carbonate solution gives a greater colour value than without the treatment; when the picramate colour is diluted, the intensity of the colour is not proportional to the dilution; clarification of sugar solutions has proved to be unnecessary in a number of cases when the picramate method was used; the intensity of the picramate colour is not proportional to the amount of sugar present; and strict empiricism in this method is necessary. A procedure is described in detail.

Defecation of Raw Beet Juice with Lime in the Cold. ***J. Vondrák.*** *Zeitsch. Zuckerind. Czecho-slov., 1924, 48, Nos. 46 and 47, 433-438, 441-444.*

Raw beet juices which had been treated with lime in the cold, and heated previous to carbonating, were found to have a more favourable composition, especially in respect of the amide content, which was only about half, compared with those obtained by the usual method of defecating at a high temperature. But they frothed during carbonatation, and gave a very bad filtering scum, which difficulty was not overcome when half of the lime was added in the cold and the rest after heating. A more favourable result, in respect of frothing and filtering, was given by fractional saturation, namely by liming the raw beet juice in the cold at the rate of 1 per cent., heating to 85°C., carbonating to an alkalinity of 0·1 grms., CaO per litre, adding another 1 per cent. of lime to the muddy juice, and again carbonating. This method of working compared with the ordinary procedure hardly offers any advantages under normal conditions, but when the roots being sliced are very impure, when they contain much nitrogen, or when they have become decomposed, then it may render good service.

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[1] Prepared by slowly dissolving 110 grms. of mercuric oxide in 80 c c. of concentrated nitric acid, then boiling, cooling, adding 30 c.c. of 5 per cent. sodium hydroxide solution, and diluting to 1 litre. This clarifying reagent is stated to be superior to lead acetate for the precipitation of proteins, tannins, and amino-acids. It more effectually removes substances having a reducing action towards Fehling's solution, which same substances exert a stronger effect on the pictrate-picric solution.

[2] Prepared by dissolving 36 grms. of picric acid in 500 c.c of a 1 per cent. solution of sodium hydroxide, adding 400 c c. of hot water, cooling after solution, and making up to 1 litre.

[3] *I.S.J.*, 1924, 279; also previous abstract.

"ANALOID" SYSTEM OF CHEMICAL ANALYSIS. "*Up-to-date Analysis*" (Pamphlet issued by Ribsdale & Co., 3, Wilson Street, Middlesbrough, England). 1924.

The "Analoid" system of analysis was an outcome of the necessity of achieving a higher degree of accuracy regularly in routine analyses of iron and steel, whilst attaining all possible speed. Its main features consist of: (1) Re-designing well-known methods of analysis so as to allow the substitution of a large number of operations by a few simpler ones in which tablets of pure reagents, the composition of which is stated, are used; (2) Standardizing the operations and giving full and exact descriptions of them so as to ensure regularity and precision of working in routine tests. In this way it becomes easy to analyse numerous types of material fixed under conditions: such as exact quantities of reagents; degree of acidity; definite temperature of precipitation, volume of liquid, etc.; combined in many cases with specially convenient apparatus. Other advantages are less handling and breakage of glassware, and practically no waste of chemicals. There are also many instances when the addition of reagents in tablet form offers very decided advantages over solutions, crystals or powders, e.g.:—The trouble of making and bottling solutions is overcome, and the opportunity for error in making and subsequent measuring is avoided; tablets keep almost indefinitely; weighing (or guessing the amount of reagents) is obviated; gas generation in a steady current effectively saturating the solution is secured; and finally, tablets permit of working with much smaller quantities of more concentrated solutions (hence, more quickly and effectively), thus often bringing about a considerable economy in reagents. As the result of the introduction of the "Analoid" system, certain methods have been largely "mechanicalized" in many laboratories (in the determination of carbon and sulphur in steel, etc.), the junior chemist being instructed to follow in detail a simple well-defined procedure. It is manifest that methods in which many of the opportunities for error have been removed must yield more accurate results than those in which they have not; and a large number of tests on various materials, made with the "Analoid" in comparison with procedures hitherto employed, have been published by authorities in support of this statement. So far the new system has been applied only to processes of analysis employed in the examination of iron and steel (as the determination of manganese, phosphorus, etc.). Its value in general analytical chemistry (e.g., in soil and manure analysis) has yet to be appreciated. But some chemists are already applying their own methods in special instances.

EFFECT OF INSUFFICIENT PURGING OF LOW-GRADE MASSECUITE ON THE PURITY OF THE FINAL MOLASSES. *Arnold H. Warren. Sugar News, 1924, 5, No 7, 338-339, 351.*

One strike may yield a low-grade sugar of 80° purity, or above, at the end of 15 mins. purging; whilst another may require an hour or more of spinning to produce low-grade sugar of the maximum possible purity. But by shortening the purging time the purity of the low-grade sugar going back into process is lowered; the drop in purity of the low-grade sugar returned to process increases the number of low-grade strikes which must be boiled and dried; this decreases the time which each strike can be left in the crystallizer and tends to increase the purity of the final molasses; the increased quantity of low-grade massecuite to be dried prohibits any increase in the time allotted to purging each basket; and this in turn prevents an increase in the purity of the low-grade sugar which would decrease the amount of low-grade boiling and relieve the congestion. In fact things move in a sort of vicious circle, from which it is extremely difficult to escape. In one factory the apparent purity of the second sugar over a considerable period averaged about 70·0; but it was found that by the simple expedient of more careful purging the average apparent purity of the second sugar could be increased to 80·0°. When the purity of a B-sugar was 70°, it was found that only 27·0 per cent. of the total solids in the massecuite was removed in the final molasses; whereas when the purity was increased to 80°, the amount reached 42·55 per cent. It is good practice to test each strike by timing the first basket purged, in order to ascertain the time required to produce as complete a separation as is possible of the molasses from the sugar, the centrifugal operator being then instructed to dry each lot the determined number of minutes.

Review of Current Technical Literature.

SUGAR DISTRIBUTION BASED ON THE GROSS WEIGHT. *Arnold H. Warren.* *Sugar News, 1924, 5, No. 8, 404.*

An "excess trash factor" (kg. of gross cane minus kg. of trash in excess of average divided by the kg. of gross cane). Then the per cent. available sugar is calculated in the usual way from the Warren Tables,[1] and the kg. gross cane multiplied by the per cent. available sugar thus obtained gives the kg. gross available sugar. Finally, the kg. gross available sugar multiplied by the excess trash factor gives the kg. of total net sugar which are actually credited to the *hacienda.* The difference between the kg. gross available sugar and the net credited to the *hacienda* represents sugar deducted as a penalty for the excess trash.

OPERATING ERROR IN THE ANALYSIS OF RAW SUGAR AND MOLASSES. *Herbert Walker.* *Sugar News, 1924, 5, No. 7, 342-344.*

A test sample of raw sugar was sent out to six different chemists in the P. I., for the purpose of demonstrating the variation in the results of the analysis, but the figures as reported show a small average error, viz., 0·13 for the polarization and 0·18 per cent. for the determination of the sucrose by double polarization. In the determination of sucrose in a sample of molasses by double polarization the results are less exact, and are as follows :—

Laboratory.	Method used.	MOLASSES SAMPLE.					Average of Five Samples.
		1	2	3	4	5	
A	H. C. A., Walker Inversion	32·78	40·89	36·26	38·42	37·18	37·11
B	Walker Inversion, Dry Lead Clarification..	33·10	40·44	34·50	37·30	37·15	36·50
C	H. C. A., Herzfeld Inversion	34·26	40·50	35·80	35·91	34·94	36·28
D	Steuerwald Inversion.	34·50	41·10	33·90	37·60	36·00	36·62
E	H. C. A., Walker Inversion	34·29	41·07	31·91	37·14	36·17	36·12
F	H. C. A., Herzfeld Inversion	34·06	40·61	35·07	36·50	35·85	36·42
Average of all Laboratories		33·83	40·77	34·57	37·15	36·22	36·51
Probable error of One Analysis.		0·48	0·20	1·05	0·59	0·57	0·23
Probable error of Average.. ..		0·19	0·08	0·43	0·24	0·23	0·09

Figures are returned for Brix and Brix-Sucrose purity values, but judging from the probable errors, the general conclusion may be drawn that, if we submit a sample of molasses to six different laboratories, and average the six duplicate determinations reported, this average gravity purity may be depended on to about ± 0·35, and the report from any one laboratory will probably be accurate to about ± 0·9. That is, if a laboratory reports a gravity purity of 38·0, the true value is a little more likely to lie inside than outside the interval from 37·1 to 38·9, provided there is no constant error in the method of analysis. Such a low degree of accuracy is far from satisfactory, particularly since these determinations were presumably made with especial care and are probably considerably more accurate than the average routine work.

INVERSION OF SUCROSE BY ACETIC ACID, PARTICULARLY IN CONNEXION WITH THE FRIEDRICH AND RATJORA PROCESS. *Emile Saillard.* *Supplément à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France.. No. 1845 of 1924.*

In the Friedrich and Ratjora process, recently examined by the author,[2] acetic acid is mixed with molasses in order to precipitate the sugar, which is subsequently separated in a suitable manner. He had found that, under the specified conditions of working, sucrose is not inverted by this organic acid, even when the amount and the temperature are relatively high. Laboratory experiments now show him that, whereas with a solution of pure sugar the diminution of polarization caused by the presence of acetic acid is about 17·5° after 144 hours, when potassium acetate is also present it is only 0·15°. Sodium formate had a similar effect. But sodium chloride, magnesium chloride, sodium nitrate, and some other inorganic salts had a distinctly contrary action, the diminution of polarization being as much as 25·95° in the case of the former salt, though less than in that of the others. His conclusion therefore is that with sugar solutions containing a mixture of mineral and organic salts, the decrease of polarization caused by the presence of acetic acid is not equal to the sum of the effects of each salt considered separately, but is equal practically to the sum of the effects of each inorganic salt present.

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[1] *I S.J.*, 1923, 39.

[2] *I.S.J.*, 1924, 557-558.

Sucrose : Water System Studied by the Phase Rule. [Concentration of Sugar Solutions by Freezing.] ***J. Babinski.*** *Centralblatt für die Zuckerindustrie, 1924, 32, No. 39, 782.*

A research has been carried out by the author in the Central Laboratory for the Sugar Industry, Warsaw, on the sucrose : water system from the point of view of the phase rule, the following phases being distinguished : liquid (the solution); mixture of the liquid and the crystalline phase of water (ice) ; mixture of the liquid with the crystalline phase of sugar ; and the mixture of the crystalline phases of water and of sugar, which latter two phases are termed eutectics. A series of determinations of the lowering of the freezing points of sugar solutions also forms part of the research, and some of values obtained corresponding to various sucrose percentages (by weight) are as follows : 21·5 per cent., 1·60 ; 35·0, 3·42 ; 41·98, 4·91 ; 50, 7·31 ; 59·0, 11·66 ; and 60·0, 11 98. In the introduction to his paper, Dr. Babinski cites a series of patents relating to the concentration of sugar solutions by freezing, and the separation of the ice thus obtained, adding that the concentration of sugar solutions by freezing in comparison with evaporation has the advantage that the sugar and other substances present in the solution undergo neither decomposition nor any other alteration of their properties.

Drying Oven for making Rapid Moisture Tests in Factory Control Work. ***Guilford L. Spencer.*** *U S. Patent, 1,482,274.*[1]

Polariscopes (Saccharimeters). ***Adam Hilger, Ltd.***, and ***P. R. Ord.*** *United Kingdom Patent, 214,712*[2]

Early Refining Industry of New York. ***C. A. Browne.*** *Second Annual Review of the Louisiana Planter, 1924, 31-39.* Cane Sugar Refining at the Present Day. ***H. Z. E. Perkins.*** *Ibid., 39-40.* Determination of Water in Mixtures of Ether, Alcohol, and Water. ***R. K. Newman.*** *Journal of the Society of Chemical Industry, 1924, 43, No. 36, 285-287T.* Efficiency of Fractionating Columns. ***G. Calingaert and F. E. Huggins, Jr.*** *Industrial and Engineering Chemistry, 1924, 16, 584-585.* Evaporation under Pressure. ***Berthold Block.*** *Chemiker Zeitung, 1924, No. 88, 510.* Coal Consumption in the Beet Sugar Factory. ***Friedr. Neumann.*** *Zeitsch. Zuckerind Czecho-Slov., 1924, 48, No. 44, 419.* Rotary and Centrifugal Pumps in the Beet Sugar Factory. ***Felix Langen.*** *Centr. Zuckerind., 1924, 32, 897, 921.* Vapour Economy in the Sugar Factory. ***Karl Schiebl.*** *Ibid., 1224, 32, 993.* Electrification of Beet Sugar Factories. *Ibid., 1924, 32, 969.* Sugar Dust Explosions. ***Erich Oppen.*** *Deut. Zuckerind., 1924, 49, 957.* New Continuous Diffusion Apparatus. ***A. Olier.*** *La Sucrerie Belge, 1924, 43, 411.* Aluminium Compounds for the Purification of Juice. ***E. Komm.*** *Centr. Zuckerind , 1924, 32, 708.* Juice Extraction Processes during the past 25 Years. ***A. Schander.*** *Deut. Zuckerind., 1924, 49, 645-651.*

J. P. O.

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[1] See *I.S.J.*, 1924, 449.

[2] *I.S.J.*, 1924, 392.

Review of Recent Patents.[1]

UNITED KINGDOM.

MANUFACTURE (FROM BAGASSE, STRAW, ETC.) OF AN ORGANIC-NITROGENOUS FERTILIZER SIMILAR TO FARMYARD MANURE. *Eric H. Richards, Henry B. Hutchinson, and Agricultural Developments Co. (Pyford), Ltd.*, of London. *219,384.* April 23rd, 1923. (No drawings; fourteen claims).

According to the present invention, an organic nitrogenous fertilizer is manufactured by bringing together a fermentable carbonaceous substance and an insoluble, or difficultly soluble, hydrolysable compound of nitrogen and maintaining these materials in contact in an hydrated state under aerobic conditions permitting free development of the ammonia assimilating organisms in the carbonaceous substance until new insoluble compounds of organically combined nitrogen are formed by the action of the organisms in the fermented mass in substantial quantity. By a "substantial quantity" is meant a quantity sufficient to render the fermented mass practicably utilizable as a nitrogenous manure, the minimum figure being 50 per cent. of the possible loading. The attainment of such a result is, other conditions being fixed, dependent upon an adequate period of contact between the carbonaceous material and the initial nitrogenous body. If this period is so short that only the minimum figure (50 per cent. of the loading) is attained, the result is a poor slow-acting manure. A fermentation mass which has not lost 20 per cent. of its dry matter and has not attained 50 per cent. of its possible loading is of little value as a fertilizer. While a "substantial quantity" in the sense indicated of re-combined nitrogen is to be understood as within the ambit of the invention, it is preferred, both for the purpose of obtaining the most efficient fertilizer and of facilitating the process of manufacture, to allow the fermentation to proceed to that point at which the carbonaceous substance is "loaded" or substantially so, with organic re-combined nitrogen, the minimum figure for total nitrogen in the final manure being 1—5 per cent. The degree of nitrogen-transformation may be determined by chemical assay, but one advantage of proceeding to the stage of "loading" is that this point may be judged by the workman himself from the appearance and general nature of the mass. The vegetable matter has lost its strength, and is generally much changed in colour. For instance, with straw, the finished product no longer possesses the typical yellow colour of straw, but is of a chocolate hue, and there is a peculiar "mucous" feel about it. With a properly rotted (i e. fermented) product from straw, substantially 90 per cent. of the total nitrogen should be in organic combination.

A simple method of carrying the invention into effect using straw as raw material is as follows:—One ton of loose straw is disposed upon an area of hard ground which, preferably, is sheltered from the wind. It is initially hydrated by spraying with a rose or other convenient sprayer. Upon the surface of the well-wetted material is scattered, as evenly as possible, about 1¼ cwt. of nitrogenous mixture which may consist of calcium cyanamide (18 per cent. of nitrogen), mineral phosphate and calcium carbonate ground to easily pass a 100-mesh sieve. Another ton of loose straw is laid over the first, and is wetted as before, and a further 1¼ cwt., of the nitrogenous mixture is distributed over the surface of the upper straw bed, and the building of the stack is continued until about ten tons of straw have been placed in position and partly wetted successively in the manner described. The quantity of water distributed on each layer of straw is about 200 gallons. The uppermost layer of the nitrogenous mixture is then covered with a few inches of straw and well wetted. The stack is left to stand until the temperature in the centre has attained at least 80°F. The period of time for such a temperature change is variable, and may last from a few days to as long as four weeks, but it seems that, other conditions being alike, large stacks heat more quickly than smaller stacks. When the temperature has risen to 80° F., 200 gallons of water are applied at the top of the stack, and the same charge is distributed over the top of the stack at three day intervals, until a total of over 10.000

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

gallons of water in all has been applied. The stack is then left until completion of the fermentation as evidenced by the colour changes and other indications referred to above. The fertilizer so obtained is a soft easily distributed mass, which is comparable in nitrogen fertilizing properties with well matured farmyard manure.

Attention has been directed to certain prior Specifications, namely, Nos. 3928/79; 22,192 91; 20,679/02; 103,448; 117,267; and 179,198. The inventors desire to say that they advance no claim to the processes described therein. The present invention is based upon biochemical changes quite distinct from those resulting in the fixation of atmospheric nitrogen by the action of organisms such as *B. radicicola* or *B. azotobacter*, and from fermentations designed to produce the plant nutritive nitrogen in ammoniacal form. But the object in view is the manufacture of an organic nitrogenous fertilizer comparable in fertilizing properties with well-rotted farmyard manure, and intended to provide a substitute for manure containing excreta, or prepared from such. The invention is wholly independent of this source of nitrogen, and depends upon a quantitative assimilation of the soluble nitrogen, arising from an initial breaking down of the original nitrogenous compound, whereby the soluble nitrogen is transformed into organic combination in a definite ratio with suitable carbonaceous material under the influence of a well-defined special group of aerobic organisms, which, acting as ammonia assimilators, bring about a change of soluble nitrogen into protein or like nitrogenous combinations.[1]

CANE CRUSHING APPARATUS, THE ROLLS OF THE CRUSHERS BEING OF DIMINISHING DIAMETERS. *F. W. Golby* (communicated by the *Fulton Iron Works Co.*, of St. Louis, Miss., U.S.A.). *219,585*.[2] (Seven figures; and ten claims.)

Prior to this invention the rollers of the first crusher of cane crushing apparatus of the type disclosed have been of the same diameter as the rollers of the second crusher. Due to the fact the body of cane which is introduced into the first crusher is in a very loose condition, the passage of the body of cane through said first crusher will compress it so that the body of cane is far below the capacity of the second crusher; and because the body of cane is below the capacity of the second crusher it will be below the capacity of each succeeding crusher and mill through which it passes. In the apparatus disclosed the inventor employs a first crusher having rollers considerably larger in diameter than the rollers of the second crusher, and a second crusher having rolls which are larger in diameter than the rolls of the other crusher and of the mills, whereby the objections recited above are eliminated. To illustrate the invention he shows a succession of crushers, or mills, adapted to act upon the cane which travels through the apparatus, as indicated by the arrows in Fig. 1. The second crusher comprises a pair of crushing rolls *A* provided with peripheral ribs *1*. These ribs are preferably V-shaped in cross-section, as shown in Fig. 4, and the ribs of one of the rolls *A* preferably overlap the ribs of the other roll, the ribs of each roll being extended into the corresponding peripheral grooves formed in the other roll. The third crusher comprises a pair of crushing rolls *B* smaller in diameter than the rolls of the second crusher whose rolls again are smaller in diameter than those of the primary crusher, and provided with ribs *2*, which correspond approximately to the shape of the ribs of the first crusher. However, the ribs *2* of the third crusher are preferably of less pitch and smaller than the ribs of the second crusher. Furthermore the co-operating ribs of the third crusher are preferably located relatively close to each other, as shown in Fig. 5. *C* designates the top roll of the first mill, *D* designates the cane roll, and *E* the bagasse roll. Each of these rolls *C*, *D* and *E* is provided with peripheral crushing ribs *3* (Fig. 6) which are finer than the corresponding ribs of the third crusher. The second, third, fourth and fifth mills each consist of a top roll C^1, a cane roll D^1 and a bagasse roll E^1 and each of these rolls, which is the approximate diameter of the rolls of the third crusher and of the first mill, is provided with peripheral crushing ribs *4*, shown in Fig. 7, said ribs being smaller and of less pitch than the ribs of the first mill. The cane is advanced to the second crusher from the first crusher *F* which is provided with a pair of crushing rolls *G* having peripheral crushing ribs *6*, said ribs, like the ribs on the rolls of the crushers already described, being V-shaped in cross section and co-operating with each other as those ribs previously described. The rolls *G* of the first crusher *F* are of much greater diameter than the rolls of the other crushers, and the crushing ribs on the rolls of the first crusher are of greater pitch than the crushing ribs on the other rolls, consequently the rolls are able to draw into the apparatus a much larger body of cane at one time than they would if they were of the same diameter as the rolls of the other crushers. As already stated, this feature of the apparatus is of the utmost importance due to the fact that the first crusher must draw into the apparatus a body of cane sufficient in volume to cause all of the subsequent crushers and mills to function to their extreme capacity. The cane is introduced into the first crusher *F* in a very loose condition; in other words, it is not very closely packed. When this loose body is introduced into the first crusher the large ribs *6* are adapted to mash and compress the cane into a comparatively compact mass which is passed on to the second crusher. It is only by increasing the sizes of the rolls of the first crusher *F* that an amount of cane may be drawn into the apparatus which, when compressed by the first crusher, will be sufficient in volume to represent the maximum capacity of the second crusher. After the cane passes through the second crusher, where it is acted upon by the finer ribs *1* which are adapted to split and shred the compressed cane and thus prepare it for the third crusher, it passes to the said third crusher, and by increasing the diameter of the rolls of the second crusher, this apparatus accepts from the first crusher and passes on to the third crusher a body of cane which will represent the maximum amount which may pass through the third crusher. The body of cane then passes from the third crusher to the first, second, third, fourth and fifth mill in turn, the rolls on said mills and the ribs on their rolls being so arranged that they will effectively squeeze the juice from the mat of the cane. To provide means whereby the speeds of the various elements of this apparatus may be regulated, a separate power generating device *10* is

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[1] This is the "Adco" process, which is reported to have more than realized expectations in the United Kingdom. Preliminary trials made with bagasse and cane trash overseas are also stated to have been satisfactory, the analysis of the finished manure as reported by official chemists having been in some cases better than the specification claimed. Extensive trials have also been carried out in Mauritius, Queensland and elsewhere, to which countries shipments of the "Adco" mixture (the composition of which is said not to have been divulged) have been made. This development originated from the Rothamsted researches on cellulose decomposing organisms, commenced by Dr. HUTCHINSON in 1917, and in view of the great possibilities of the process a company was formed in 1921 to apply it in practical agriculture.—ED., *I.S.J.*

[2] Also U.S. Patent, 1,506,002, in the name of HENRY HURTER.

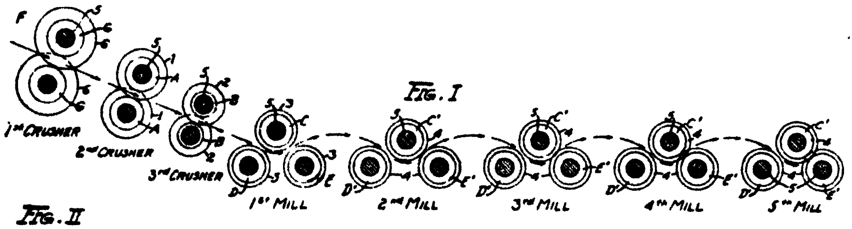


Fig. I

Fig. II

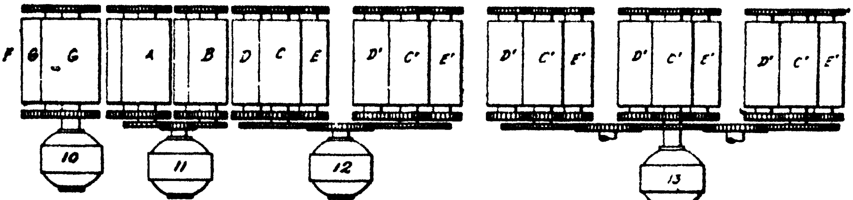


Fig. III

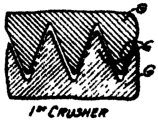


Fig. IV

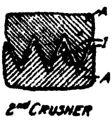


Fig. V

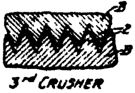


Fig. VI

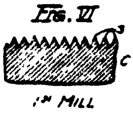
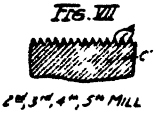


Fig. VII

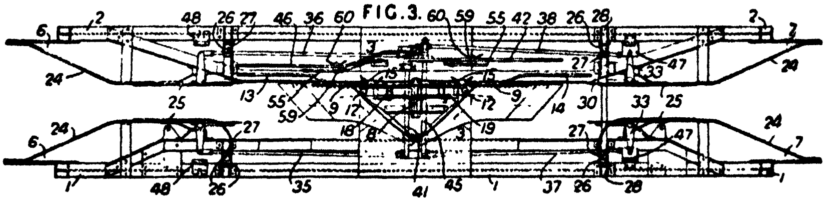


employed for actuating the first crusher, and a power generating device *11* which actuates the second and third crushers only, A power generating device *12* is connected to and actuates the first and second mills, and a power generating device *13* is connected to and actuates the second, third, fourth and fifth mills.

CANE HARVESTER. *H. N. van Dijk*, of The Hague, Holland. *218,079*. May 26th, 1923.

A machine for harvesting or ploughing out sugar cane and root crops, etc , comprises two long skids adapted to be drawn backwards and forwards by cables and windlasses and provided with means for raising the canes, etc., and with a double plough adapted to be tilted about a traverse axis to raise one share out of work and lower the other for the return journey. The skids *1*, *2* are connected together by a central sole-plate *3*. The double plough is pivoted on a bolt *8* and is provided with screws *12* that engage the sole-plate when the corresponding share is lowered, and thus regulate the depth of work. The skife-plate *9* is provided with handles *13*, *14* and can be locked in various positions by means of studs *15* passing through slots. When the plough is turned into an horizontal position with both shares out of the ground, it is held in that position by stops on spring-controlled levers *18*, *19*, one of which must be moved by hand before the plough can be put into operation. The canes, etc., are lifted and guided by horns *6*, *7* comprising upwardly and inwardly inclined bars *24* leading to horizontal bars *25* which end some distance in front of the shares. A movable cross-bar *28* is attached behind the plough to strengthen the frame. It is secured in bridge-pieces *26* by screws *27*, and is moved to the other end of the frame at each headland. A seat and a foot-plate may be provided. Two coulters *30* having sloping cutting-edges are mounted in front of each share. The implement is steered by turning the front coulters about vertical axes by means by levers *33* connected by rods *35* . . . . *38* to arms on rock shafts *41*, *45* operated by hand-levers *42*, *46*, the real coulters being held in mid-position by hinged catches *47*, *48*. The levers *42*, *46* are mounted in such a way that the one not in use may be turned down clear of the crop. The lever in use may be locked in any position by means of a hinged rod *55* sliding through an eye-bolt *59* provided with a clamping-nut *60*.

FIG. 3.



NITROGENOUS FERTILIZER. *M. Igawa and Asahi Garasu Kabushiki Kaisha*, both of Tokio, Japan. (*A*) *218,401*. December 21st, 1922. (*B*) *219,748*. January 29th, 1923.

(*A*) Nitrogenous fertilizers are manufactured with the addition of a small quantity of colloidal magnesium silicate. (*B*) Colloidal magnesium silicate, as used in the previous specification, is replaced by "any other inorganic colloid," colloidal aluminium oxide, manganese oxide, and aluminium silicate being mentioned as suitable. (Reference has been directed by the Comptroller of the Patent Office to Specifications *2994* of 80, *20,258* of 1914, and *184,800*.)

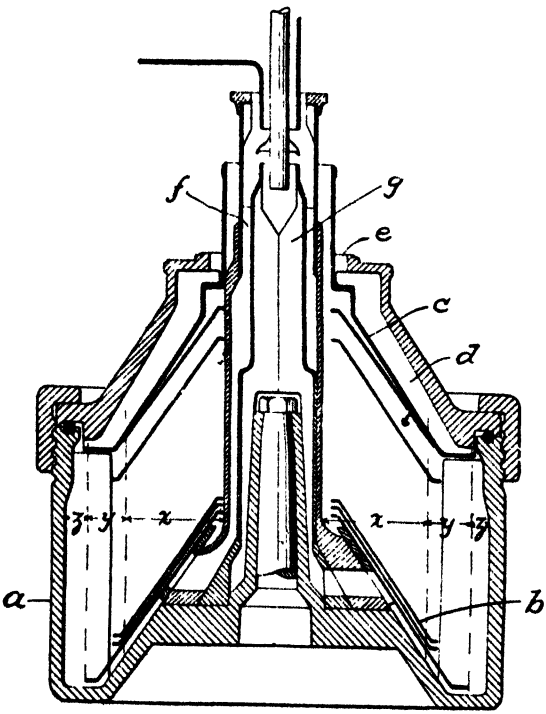
MOULDING REFINED SUGAR. *Soc. Anon. des Raffineries et Sucreries Say*, of Paris, France. *218,624*. May 14th, 1924 ; convention date, July 4th, 1923.

Comprises modified apparatus for discharging the moulding blocks, consisting of two conveyors arranged at right angles, the first receiving the blocks by a pusher, and the second receiving the blocks therefrom by the action of a second pusher, upon plates supplied from a magazine.

UNITED STATES.

Centrifugal Clarification of Cane Juice. *Cyrus H. Hapgood* (assignor to the *De Laval Separator Co.*, of New York, U.S.A.). *1,92,168.* April 29th, 1924.

Solid impurities, e.g., fibre, etc. (heavier than the juice), are "sludged out" by centrifugal force with the aid of an added liquid of greater specific gravity than the liquid under purification, which added liquor may or may not be of greater specific gravity than the impurities. In practice a mixture of paraffin oil and carbon tetrachloride is used,[1] and a special type of centrifugal, either the Snyder[2] or the Hall,[3] preferably the latter (here illustrated); but the liquid used for the removal of the impurities from the bowl is not the oil-tetrachloride mixture, but a still heavier (and cheaper) liquid, e.g., brine, to form a cushion enveloping the oil-tetrachloride mixture, which is continuously supplied to and removed from the bowl, the oil-tetrachloride mixture of intermediate gravity being held in the bowl, acting as a stationary permeable partition through which the impurities travel into the outer travelling cushion, by which such impurities are carried out of the bowl. No technical difficulties of a mechanical character present themselves. It is only necessary first to run into the bowl a pre-determined quantity of brine and oil tetrachloride and then to continuously admit brine and cane juice, the rate of admission and discharge of the brine being so proportioned to the capacity of the heavy discharge outlet from the separating compartment that said outlet will at all times be sealed by the brine so as to substantially exclude the escape of the mixture. It is, of course, necessary to feed the brine and the cane juice into the separating compartment of the bowl through separate supply channels and to deliver the brine into such compartment outside the zone of partitioning liquid and to deliver the cane juice into such compartment inside said zone. This method of feed is rendered possible by the employment of a bowl of the Hall type. The initial admission of the compound liquid should be through the brine inlet. A centrifugal machine of the Hall type is illustrated in the accompanying drawing, which is a vertical sectional view through the bowl: *a* is the bowl body; *b* a multiple disc liner thereon; *c* the top disc around the periphery of which the heaviest liquid is discharged into the channel *d* leading to the outlet *e*; *f* a feed tube through which the cane juice is admitted to the interior of the separating compartment at a distance from the bowl periphery, the juice flowing up through aligning orifices in the liner and distributing itself through the separating space in the course of its upward flow; *g* a feed tube within the feed tube *f* and communicating, through passages beneath the liner, with the peripheral part of the bowl. In operation, the liquids arrange themselves into an inner zone *x* of cane juice, an inter-



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[1] Patent application. Serial No. 467,529. [2] U.S. Patent, 1,283,343. [3] U.S. Patent, 1,492,852.

mediate permeable partition *y* of the solution of paraffin and carbon tetrachloride, and an outer zone *z* of brine sealing the exit around the edge of the top disc.

It is clear that the process is not limited to the use of the particular illustrative and preferable liquids specified. Any liquid, simple or compound, including any oil of mineral, vegetable or animal origin that is not miscible with cane juice, that will not impart thereto any disagreeable or objectionable property, and which is of the proper specific gravity, may be substituted for the solution of paraffin and carbon tetrachloride. And any liquid of sufficiently high specific gravity and which is not miscible with the partitioning liquid, may be substituted for brine.

PRESERVATION OF BAGASSE (FOR ITS MANUFACTURE SUBSEQUENTLY TO PAPER PULP). *Treadway B. Munroe* (Assignor to *C. F. Dahlberg*, of Minneapolis, Minnesota, U.S.A.). *1,479,419*. January 1st, 1924.

When bagasse which subsequently is to be used for the production of paper pulp is exposed to a damp and hot atmosphere, alcoholic, acetic, and humic fermentions set in, as the result of which the strength of the fibre is destroyed. As a means of obviating this deterioration, the bagasse is treated according to this invention with a substance, e.g., caustic lime, which will not only prevent the fermentations mentioned, but will react with the liquid constituents to generate sufficient heat to partially "cook" the product while preserving it. Lime is therefore sprinkled on the bagasse when spread out, the mass passed into a press, and bound into bales. When after a time the bale is opened preparatory to subjecting its fibres to the regular "cooking" action before forming them into a finished board, these baled fibres are found to possess not only their full strength free from all deteriorating influences, but to be in a partially "cooked" or softened state, so that the normal "cooking" is greatly facilitated, or even may be obviated.

DECOLORIZING CARBON MANUFACTURE. (*A*) *Milton C. Whitaker* (assignor to *U.S. Industrial Co.*, of West Virginia, U.S.A.). *1,504.730*. August 12th, 1924. (*B*) *John C. Woodruff and Thorne L. Wheeler*, of New York, N.Y., U.S.A. *1,505,517*. August 19th, 1924. (*C*) *Karl Rhode*, of Berlin, Charlottenburg, Germany. *1,505,496*. August 19th, 1924.

(*A*) Claim is made for the process of producing porous decolorizing carbon having highly active surfaces, comprising feeding distillery waste into a highly heated zone to drive off the water, and then feeding it into a zone of a lesser temperature to complete the carbonization. (*B*) A process of increasing the absorptive power of carbon by oxidation, which comprises conveying the carbon through an elongated heated reaction zone, distributing an active oxidizing agent throughout the reaction zone, so that all of the carbon therein is simultaneously subjected to the action of the oxidizing agent before the latter is materially contaminated by the end-products of the reaction, the carbon being maintained during the reaction at a temperature sufficiently high to ensure rapid activation by the external application of heated combustion products. (*C*) A process of manufacturing active carbon, consisting in impregnating a carbonaceous material of fossil origin with alkali and heating the mass to a temperature of approximately 1000° C. with the exclusion of air.

ALCOHOL MOTOR FUEL. (*A*) *Donald B. Keyes* (assignor, *U.S. Alcohol Co* , of West Virginia, U.S.A.). *1,496,810*. June 18th, 1924. (*B*) *Daly O. White*, of Portland, Ore., U.S.A.). *1,501,383*. July 15th, 1924. (*C*) *Elmer H. Records*, of Masonia, Idaho, U.S.A.). *1,471,275*. April 22nd, 1924. (*D*) *F. W. Ferrer* (assignor to *M. M. Power*). *1,496,260*. June 3rd, 1924.

(*A*) A liquid fuel having a composition comprising a lower member of the monohydric alcohol series, a butylene, and a light petroleum distillate. (*B*) A liquid fuel composed of alcohol and a relatively small addition of ammonium chloride. (*C*) A liquid fuel comprising:—Alcohol 81·5; benzol 10·0; ethyl ether 2·0; and naphthalene 3·5 per cent. (*D*) This fuel consists of:—Acetone, 125; camphor, 5; methyl alcohol, 180; ether, 135; and alcohol 40 parts by weight.

PROCESS OF REFINING MOLASSES, PARTICULARLY BEET, FOR THE PRODUCTION OF SUGAR AND OF SYRUP FOR HUMAN OR CATTLE FOOD.[1] *Heber C. Cutler*, of Salt Lake City, Utah, U.S.A. (assignor to *United States Syrup Co.*, of Utah). (*A*) *1,493,967*. May 13th, 1924. (*B*) *1,494,218*. May 13th, 1924.

(*A*) Beet molasses, in its usual alkaline state, is heated to boiling point, mixed with sufficient strong mineral acid (e.g., hydrochloric) to neutralize the bases present, but insufficient to cause free acidity, and the mixture (filtered, if necessary) submitted to osmosis. After neutralizing any free acid that may have developed, the liquid is treated with phosphoric acid and kieselguhr, and filtered. It is then concentrated; but in the early stages of evaporation it is desirable to add water from time to keep its content at about 80° Brix "in order to purify more readily the mixture of volatile matter and traces of acid," and the albuminoids separated during this operation are later removed by filtration (using kieselguhr) previous to transferring to the vacuum pan, the clear syrup thus obtained being subsequently boiled and crystallized in the usual manner.

(*B*) In this specification the object is to produce a syrup from refuse beet molasses for human or cattle consumption, its ash content not exceeding 5 per cent., nor its water content 25 per cent. This is accomplished by treating it with a suitable amount of hydrochloric acid (or other inverting substance) so as to cause from 5 to 60 per cent. of the sucrose present to be hydrolysed, which conversion is assisted by heat. Salts, now present as chlorides, are removed by osmosis, and the resulting liquid (containing about 80 per cent. of water) is heated at atmospheric pressure to expel volatile impurities, filtered or settled, and concentrated in a vacuum pan to a water content of not more than 25 per cent.

APPARATUS FOR HOISTING AND TRANSFERRING CANE. *German V. Rodriguez*, of Manzanillo, Cuba. *1,467,013*. September 4th, 1924.

Objects of the invention are to provide an improved apparatus of this class which is less expensive than those at present in use, which is simpler in its operation and very efficient. Also to provide an apparatus in which the use of power for transporting the elevating car is eliminated, this operation being done automatically by a system of pulleys conveniently disposed and actuated by the weight of the car or by the weight of the load; and to provide means for stopping the transporting car and retaining the same position when loading or unloading. Claim 2:—In a load transferring apparatus, the combination of a framework, an inclined track disposed at the top of said framework, a car adapted to travel on said track, a grooved pulley secured at one end of said framework and a sprocket wheel disposed at the other end of said framework, a chain passing over said pulley and sprocket wheel and secured to both ends of said car, a friction brake for holding said car at any desired position on said track, a carrier suspended from said car, means for elevating said carrier comprising a pair of bearings, a shaft mounted on said bearings, a drum disposed on said shaft, a pair of pulleys at each end of the framework, a pair of pulleys on said car, a pair of pulleys secured to said carrier, cables passing over all of said pulleys, one end of said cables being secured to said shaft and the other end of each of said cables attached to the bottom of said car, a cable having one end secured to said drum and the other end to a motor, a friction brake for holding and releasing said drum, and means for controlling said elevating mechanism comprising a shaft, a toothed wheel secured to said shaft, a pawl adapted to engage said wheel, and a cam for engaging said pawl.

MILL HYDRAULIC PRESSURE GEAR. *Luis Diaz Hidalgo*, of Habana, Cuba. *1,494,357*. May 20th, 1924. (Three figures: five claims.)

As usual, the mill comprises a frame including a base *1* and standards secured to the base, the standards being surmounted by caps *3* held in place by bolts *4*. Vertical guideways *5* are fashioned in the standards. In the drawing only the upper roller is shown. Upper bearings *21* are mounted to move in the guideways of the standards. The numeral *24* designates a power-driven upper shaft journaled in the bearings *21*. A roller *34* is carried by the shaft *24*, and rotates therewith, the roller *34* being of considerably less diam. than the bottom roller. The caps *3* are provided with vertical passages *37* enlarged at their upper ends to form chambers *38*. The caps *3* are provided with circumferentially spaced lugs *39* projecting into the chambers *38* In each chamber *38* is located a head *40* having eyes *41* whereby it may be manipulated, the head having lugs *42* engaged beneath the lugs *39* and of such size as to move vertically between the lugs *39* when the head *40* is rotated so that the lugs *42* are no longer beneath the lugs *39*. The head *40* is supplied with a reduced piston *43*. A cylinder *44* is seated in the chamber *38*,

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[1] See also *I.S.J.*, 1921, 706; and 1922, 292.

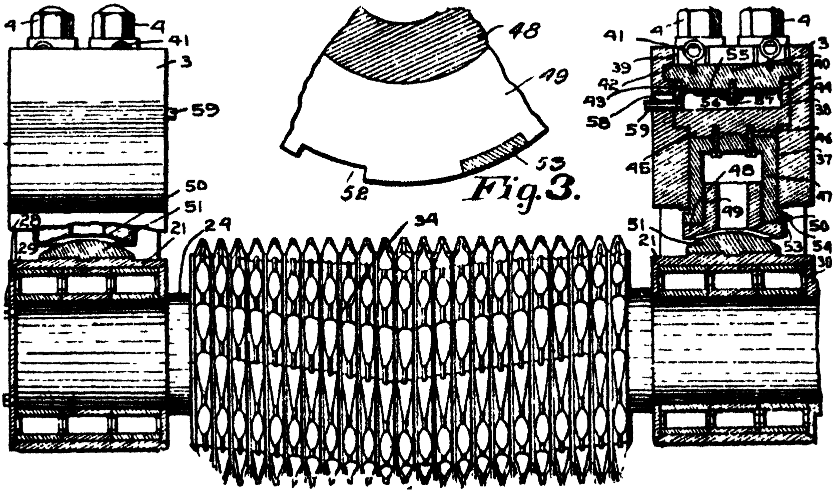

Fig. 3.

and includes a reduced neck extended into the passage *37*. The cylinder *44* is adapted to slide vertically on the piston *43*. A packing *55* is held by a plate *56* and a securing member *57* to the lower end of the piston *43*, and has a depending flange bearing against the side wall of the cylinder *44* to afford a fluid-tight joint. The cylinder *44* includes a hollow member *47* located partly in the passage *37* and held upon the reduced neck of the cylinder by securing elements *46* A foot *48* is threaded for adjustment into the member *47*, as indicated at *49* and has in its lower end, a concaved seat *50* adapted to co-operate with a convexed block *51* mounted on the bearing *21*. In order to prevent the foot *48* from rotating in the member *47* of the cylinder *44*, notches are formed in the edge of the foot *48*, any notch being adapted to receive a locking strip *53* attached to the lower end of the member *47* of the piston *43* by a securing element. When it is desired to adjust the effective length of the movable member of the hydraulic press, the part *48* may be threaded upwardly or downwardly in the part *47*. When the aforesaid adjustment has been made, the locking strip *53* may be seated in one of the notches of member *48*, the strip being attached to the element *47* by means of the securing element *54*. Should it be desired to remove the cylinder *44*, thread *40* may be rotated until its lugs *42* no longer are beneath the lugs *39* which project into the chamber *38*. Then, the head *40* may be removed, the lugs *42* on the head passing upwardly between the lugs *39* on the cap *3*. When the mill is in operation, the foot *48*, the member *47* and the cylinder *44* are in almost continuous vertical movement. In order to permit the aforesaid movement, the caps *3* are provided at their inner sides with vertically elongated slots *58* receiving nipples *59* which communicate with the cylinders *44*, the nipples being carried by the cylinders. The main pressure pipe is connected with the nipples *59* by flexible tubes, to the end that the cylinders *44* may move vertically with respect to a pipe, the latter element being fixed, ordinarily.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to October 29th	2,749,986	..	2,611,273
Deliveries ,, ,,	2,743,650	..	2,610,696
Meltings by Refiners ,, ,,	2,705,710	..	2,518,080
Exports of Refined ,, ,,	190,000	..	195,000
Importers' Stocks, October 29th	7,130	..	577
Total Stocks, October 29th	50,309	..	88,232
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons	1923-24 Tons.
Exports	3,430,488	3,114,777	3,512,100
Stocks	333,411	285,550	273,426
	3,763,899	3,400,327	3,785,526
Local Consumption	117,548	98,000	100,000
Receipts at Ports to September 30th	3,881,447	3,498,327	3,885,526

Havana, September 30th, 1924.

J. GUMA.—L. MEJER.

Sugar Crops of the World.

(Willett & Gray's Estimates to October 31st, 1924.)

	1924-25. Tons.	1923-24. Tons.	1922-23. Tons.
CANE.			
America	7,366,800	7,059,461	6,541,323
Asia	5,694,000	5,821,849	5,460,112
Australasia	420,000	339,859	343,832
Africa	605,500	593,121	556,853
Europe	8,000	7,871	13,918
Total Cane	14,094,300	13,822,161	12,916,038
BEET.			
Europe	6,700,000	5,065,334	4,574,325
U.S.A.	875,000	787,217	615,936
Canada	20,000	16,500	12,400
Total Beet	7,595,000	5,869,051	5,202,661
TOTAL CANE AND BEET	21,689,300	19,691,212	18,118,699

United Kingdom Monthly Sugar Report.

Our last Report was dated the 10th October, 1924.

The market during the earlier part of the period under review maintained a steady tone, subsequently it developed considerable weakness, and latterly has generally been flat on reports of larger beet and cane crops than formerly anticipated and prices have receded about 1s. 6d. per cwt.

Trading in the terminal market was in very small volume in October, but in November transactions have been more numerous and good quantities changed hands at a lower level of prices. October held up remarkably well and was finally liquidated round about 21s. 6d. Tenders were not heavy, and about 2000 tons were delivered on October contracts during the last few days. November sold from 20s. 6d. up to 20s. 9d., and finally down to 18s. 9d. Dealings in December were heavier than other months, and this month was sold from 20s. to 20s. 3d. to 18s. 3d. The discount on forward months is not now so pronounced, and a good business has been done in March from 19s. 9d. to 20s. to 18s., May 19s. to 20s. 1½d to 18s. 3d., and August 20s to 18s. 4½d. The latest prices are November 18s. 6d., December 18s. 1½d., March 18s., May 18s. 3d., and August 18s. 6d.

Trading in actual sugars has been slow, prices have sagged, and premiums on nearby sugar have been quickly disappearing. As more Continental supplies became available the trade continued their policy of buying strictly from hand to mouth, and there has been the keenest competition to realize holdings. The demand for export ceased very abruptly, but as the Javas were nearly all cleared some time ago and there were no further shipments due in the U.K. this class of sugar did not press. Fine Granulated on the spot has fallen from 35s. 9d. to 33s. 6d., White Javas from 34s. 6d. to 32s. 6d. Continental Granulated for ready and prompt shipment has been more abundant, Dutch sold at 23s. to 20s., while isolated parcels of Czecho Granulated sold down from 22s. 6d. to 19s. 6d. American Granulated from first hand has been above the parity, but a few stray second-hand parcels have been sold at competitive prices. Czecho Granulated for first half November sold from 21s. 3d. to 20s. 3d., November from 21s. to 19s. 6d., December from 20s. 10½d. to 19s. 3d. Dutch Granulated from October sold at 22s. to 21s. 3d., November from 21s. to 19s. 9d., and December 20s. 6d. to 19s. 6d. A certain amount of business in Continental Granulated was done in January/March at 20s. 6d. down to 19s. 3d., and in April/August at 20s. 6d. to 19s. 6d. Belgian Granulated and Crystals for November/December were more freely offered and were sold from 20s. 1½d. to 19s. German Granulated has been quoted at competitive prices, but not much sugar has actually been sold to the U K. market.

The British Refiners have had great difficulty in getting sufficient cheap raws to compete with foreign Refined, but in spite of this they have been forced to reduce their prices. On the 23rd October prices were reduced by 6d. per cwt., on 3rd November Granulated was quoted 9d. per cwt. lower and Cubes were marked down 1s., and on 10th November Granulated was again reduced 9d. and Cubes 1s. per cwt. The latest quotations are No. 1 Cubes 39s. 6d., London Granulated 35s. 10½d.

Business in raws has been difficult, Cubans were out of parity and transactions were practically confined to Peru, 96 per cent. from 20s. c.i.f. to 17s. c.i.f. A fair business has taken place in 88 per cent. Beet from Poland and Czecho-Slovakia at 19s. to 16s. c.i.f. according to delivery. Australian 96 per cent. sold at 19s. 6d., and Brazils at 17s.

The demand for Refined in America has been poor compared to the consumption during the autumn. Raws were sold up to 4 cents until the last fortnight when Perus were pressing in New York and were sold down to 3¼ cents. Cubans for next year were sold at 3 cents c.i.f. and one or two cargoes were sold for February and March shipment to Europe from 16s. to 15s. c.i.f. December futures relapsed to 3·65, and March to 2·95.

Mr. F. O. Licht has adjusted his estimate of the European Beet crop as follows :—

	Tons.		Tons.
Germany	1,640,000	Spain	255,000
Czecho-Slovakia	1,450,000	Hungary	200,000
France	800,000	Sweden	143,000
Poland	450,000	Denmark	140,000
Russia	430,000	Austria	68,000
Italy	360,000	Other countries	320,000
Belgium	375,000		
Holland	330,000	Total	6,961,000

from which it will be noted that the chief increase is in Germany.

21, Mincing Lane,
London, E.C. 3.
November 10th, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 312. DECEMBER, 1924. Vol. XXVI.

Notes and Comments.

The Government's Aid towards the Beet Sugar Industry.

As we anticipated would be the case, the new Unionist Government has decided to adopt and carry out the proposals made by the late Government for the grant of a subsidy for a period of ten years to the home beet sugar industry; and it did not wait for the assembling of Parliament before announcing its decision—which it had come to as part of a larger policy of fostering agriculture generally in this country. This subsidy is apparently to be on the diminishing scale devised by Mr. SNOWDEN, coupled with a minimum price to the growers during the initial years.

It is announced that the necessary measures have been prepared and will be presented to Parliament when it meets for business. It will not be possible to complete all the stages before Christmas, but it is the intention of the Government to secure their passage into law without any avoidable delay.

The proposed subsidy, *which will apply to sugar manufactured during the current season* will be at the rate of 19s. 6d. per cwt. for the four years from 1924-25 to 1927-28 inclusive; at the rate of 13s. per cwt. for the three following years; and at the rate of 6s. 6d. per cwt. for the three final years. These rates will apply to sugar of a polarization exceeding 98°; for sugar of lower polarizations the rates will be reduced according to scale. The subsidy has been fixed at a rate which will enable the sugar factories to pay excise duty at the preferential rate, which at present is 9s. 8⅔d. per cwt., and the industry would not be adversely affected in future by any reduction in the Customs duty on imported sugar, since the Excise duty would be proportionately reduced at the same time.

It will be a condition of payment of the subsidy that the sugar manufacturers should pay during the first four years a minimum price of 44s. per ton of beet of 15½ per cent. sugar content, with an addition or deduction of 3d. per ton in respect of each one-tenth per cent. of sugar content above or below 15½ per cent.

In addition to aiding the manufacturers and growers of the sugar, the Government have also adopted the suggestion put to them by the British Empire Sugar Machinery Manufacturers Association (as set forth in our last issue),[1] for it proposes that in the case of any new sugar factories it shall be a condition of the payment of the subsidy that not less than 75 per cent. of the value of the machinery and plant shall be of British manufacture, unless the Minister of Agriculture for any special reason dispenses with this condition.

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[1] *I.S.J.*, 1924, 572.

All this is very satisfactory, and the Government is to be commended on coming to so prompt a decision and announcing it without further delay, as it thereby relieves the financial side of the industry of the drawbacks of uncertainty. It would seem that the present intention of the Government is not to depart from the diminishing rate at which Mr. Snowden fixed the subsidy over a period of ten years; but it may be assumed that if the industry justifies its existence sufficiently, neither the present nor, we must hope, any future Government, whether Unionist or Labour, will allow it to suffer should it be clearly demonstrated that it needs continued preferential treatment. At any rate the industry knows now definitely its minimum advantage for ten years to come, and with factory projects springing up all over the country, it will not need ten years to prove the venture a comparative success or the reverse.

Some Development Figures.

It is interesting to note what the British Sugar Beet Society thinks can be done in this country within reason. In an interview which Mr. Wood, its Secretary, gave to the *Times*, he postulated that if only one-quarter of the sugar imported into this country was produced at home, about 400,000 acres of beet would be grown. Forty thousand additional men would be employed on the land with a wage bill for 30 weeks of each year amounting to not less than £1,500,000. Thirty thousand men would also be engaged in the factories on sugar production and their wages would reach one million sterling each manufacturing season from October to January. In addition to the traffic of over 3,500,000 tons of beet it would involve traffic of 300,000 tons of coal, 150,000 tons of limestone, and 180,000 tons of dried beet pulp as well as the sugar. Yet, with the exception of the sugar, this traffic would in no respect displace existing traffic. The rail freights on beets alone would be not less than one million sterling. Further, the 50 factories which would have to be built to supply one-quarter of this country's requirements would involve a capital expenditure of from 15 to 25 millions sterling, of which 10 to 15 millions sterling would be paid directly or indirectly in wages.

This last year over 20,000 acres of beet were grown. That represented only 5 per cent of the acreage required to supply the 50 factories necessary to produce one-quarter of this country's sugar requirements.

British Machinery to be Preferred.

The condition made as to British machinery predominating if the subsidy is to be obtained is only bare justice to the home sugar machinery industry, which in the recent past has suffered from the vicissitudes of the colonial cane sugar industry, the incidence of hostile tariffs in foreign countries, and also from the upheaval of the war. Tariffs are universal, and there can hardly be a single foreign sugar producing region into which British machinery has free entry, and there is no reason why if British engineering firms can supply the necessary plant for home beet factories they should not be given a preferential position. There is nothing to prevent foreign consulting engineers and advisers from taking a hand in designing the factories, and probably such will continue to be given the opportunity in view of their greater experience in the technique of beet sugar manufacture. But the outlay on machinery manufacture with its large item of workers' wages should rightly be retained in this country.

Notes and Comments.

The Preference to British Cane Sugar.

At the time of writing the Government has not made any official pronouncement as to its intentions towards Empire cane sugar; but it has been semi-officially hinted that these will comprise the resolutions passed at the Imperial Economic Conference in London, in October, 1923 (when Mr. BALDWIN was Prime Minister). At that date Empire sugar enjoyed a preference of one-sixth the basic rate of 25s. 8d. per cwt., equivalent to 4s. 3½d. per cwt. or nearly one halfpenny per lb. of sugar. The then Government offered consequently to guarantee that if the sugar duty were further reduced, the preference should for a period of ten years not fall with it, but be maintained at the rate of practically one halfpenny per lb. so long at least as the duty on foreign sugar did not fall below that level.[1] If, indeed, it be the case that the coming form of Preference to Imperial cane sugar is to be on this basis, then since the present duty on imported foreign sugar is 11s. 8d. per cwt. of refined, the duty on British cane sugar will be 11s. 8d. *less* 4s. 3½d. = 7s. 4½d.

If cane sugar from the Empire pays 7s. 4½d. per cwt. import duty, will the excise duty on home grown beet be lowered to the same figure?[2] If so, and if the total advantage of home beet over foreign beet and cane is to remain at 21s. 8d., the actual amount of the subsidy will have to be 21s. 8d. *less* 4s. 3½d. = 17s. 4½d., or 2s. 1½d. less than was to have been paid under Mr. Snowden's scheme.[3] However, this is necessarily speculation based on previous enactments, and for details we must wait for the Government's official pronouncement, which we hope will not be long delayed, since it is just as important for the overseas cane industry to know immediately where it stands as it is for the home grown beet interests to do so. It may however prove to be the case that no exact figures will be given till the Budget is issued in the Spring.

The New Sugar Crops of the World.

Messrs. Willett & Gray have lately published their first estimates of the 1924-25 sugar crops of the world.[4] In their view the cane sugar crops of the Americas show at this early date a possible increase of some 300,000 tons; but probable increases in Cuba, Porto Rico, Santo Domingo and some other countries are offset by decreases in certain other regions. In the case of Cuba, where exceptionally large extensions have been made in the new plantings and the crop has experienced very favourable weather during the growing period so far, the indications would point to a large increase in the forthcoming crop. But political excitement and labour unrest with the threat of strikes are militating against the settled conditions so desirable for a bumper crop, so making allowance for these contingencies Willett & Gray are inclined to look for a crop of about 4,300,000 tons only. In the far East increases are indicated in the crops of Java, Formosa, Japan and the Philippines; but are offset to some degree by a probable decrease in the production in India. Australia for its size shows a good increase. The total cane crops of the world as estimated show an increase of 389,000 tons over the 1923-24 season.

The beet crops of Europe are estimated by F. O. LICHT at 6,961,000 tons, an increase of 1,903,240 tons over the previous year. This increase constitutes the larger part of the total increase of all crops this year. Without any doubt, in the opinion of Willett & Gray, this estimate of 6,961,000 tons may be considered a maximum figure with reductions certain in many of the European crops from now on. The American domestic beet crop is now expected to have an outturn of 875,000 tons.

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[1] *I.S.J.*, 1923, 561.

[2] We assume the figures given on page 625 are drawn up primarily to serve for the 1924-25 fiscal year and are subject to revision next Budget.

[3] *I.S.J.*, 1924, 402.

[4] The totals were given on page 623 of our November issue and we reproduce the full figures on pages 678 and 679.

The grand total of cane and beet sugar in the world is provisionally estimated by these statisticians at 22,082,200 long tons, as compared with 19,698,888 tons in the 1923-24 campaign, an increase of no less than 2,383,312 tons.

The Cuban Crop.

Later advices from America show that the new Cuban crop operations are being delayed by adverse weather and by labour troubles, and few mills will be working till January, though normally December sees a large proportion of the factories starting grinding. According to Lamborn's Report, a sufficient period of prolonged dry weather has not been experienced to ripen the cane and assist an early start of crop operations. Furthermore, the labour situation continues far from satisfactory and according to all reports is becoming more threatening. The Cuban Government is said to have appointed military supervisors for a number of mills affected by labour troubles, and cable advices from Havana to the London press indicate that a number of the foreign ringleaders of the disturbances, mostly Spaniards, have actually been arrested and deported as undesirables; they were charged with being implicated in the strikes at the sugar mills. The workman's unions have retaliated by threatening a general strike unless the Government drop their drastic methods.

If the strike spreads, it will naturally delay further the commencement of the grinding operations and the delivery of new crop sugars to U.S. ports. Meantime, supplies of the old crop are decreasing rapidly and there are only small stocks left in the island.

The American Political Position.

While we in this country have had a conclusive general election which has placed the Conservative Party in real power, the United States have had a no less conclusive presidential election which has confirmed the Republican nominee, President Coolidge, in office for the next presidential term. The main impression of this election has been that American politics do not desire to see the tariff whittled down nor trade disturbed; and as regards sugar, the results ensure that the domestic industry is not less adequately protected than it has been for some years past.

Wembley, 1925.

The British Empire Exhibition at Wembley during 1924 was shorn of some of its incentive to success from the fact that the then Government of the Labour Party had coldshouldered all proposals for improved economic relations with the Dominions and Colonies. In spite of this, Wembley was a profitable experience for many classes of trade. But it was felt that after the heavy outlay of erecting the Exhibition buildings, one season—and that an abnormally wet one—was hardly sufficient to exhaust its show possibilities, and down to the date of closing hopes were expressed that it might be possible to re-open next year. Unfortunately for the expedition of arrangements, the political crisis supervened and delayed a decision being arrived at till late in November. The victory of the Conservatives at the polls placed in power the party most favourably disposed to Imperial reciprocity, so it is not surprising that one of the first acts of the new Government was to vote for a 1925 Wembley providing the overseas authorities were prepared to co-operate. The latter have since, with hardly any exceptions, signified their intention of participating anew; so the re-opening of the Exhibition next May is now assured. It will not however be a duplicate of 1924; some firms and exhibits will drop out and room for others (who from one cause or other neglected to take space in 1924) will be available. But we gather space is being rapidly booked up already.

We could wish that British sugar machinery firms would make a better showing, even if only to the extent of exhibiting models and not full size plants, as was done by one leading Glasgow engineering firm.

The Literature of Plantation Work.

One of the signs of the times in the sugar industry is the enormous increase in purely plantation literature during the past few years. Although always ready to open our columns to this agricultural side of the industry, we have during the past five years definitely set apart a certain portion of each issue to papers on the subject; but it has not infrequently been found difficult to obtain suitable material to fill it, always excepting the voluminous writings on pests and diseases. Much information has been available at times about Hawaii (outside the carefully locked pages of *The Record*), the Philippines, Porto Rico, Queensland and India; but we have passed over a great deal, with regard to the last-named especially, as not of sufficient interest for our readers in more tropical countries where the agricultural methods are more advanced. But little information has been available as to the details of plantation work elsewhere, excepting in the somewhat arid and often belated annual reports. Now, however, all is changed, and the difficulty is the other way. Well prepared papers dealing with the climatic conditions, soils, methods of cultivation, and their difficulties continue to reach us from all quarters, and we find it impossible, with our limited space, to deal with all of these as punctually as we would wish. As instances of voluminous reports of this class, mention may be made of the Congress Number of the *South African Sugar Journal* from which in our last issue we abstracted several papers containing a good deal of information concerning conditions in that sugar belt.

Another Beet Sugar Factory.

The fourth beet sugar factory to be projected in this country is to be situated at Kidderminster. This district was one of the earliest to consider the possibilities of sugar beet cultivation; but when it came to endeavouring to raise the necessary capital in 1923 failure resulted owing to the uncertain outlook. The new beet sugar subsidy proposed by Mr. SNOWDEN and confirmed by the present Government has of course altered matters; and now it is announced that the Anglo-Scottish Beet Sugar Corporation is to cooperate with the local interests in building a factory on a 40-acre site at Oldington, near Kidderminster. A company, called the West Midland Sugar Company, Ltd., with head office at Kidderminster, has just been registered with a capital of £250,000, the leading directors of the above Corporation being on the Board. The local interests have undertaken to raise £85,000 of the capital required. The factory should be in operation next season.

Apart from Kidderminster, the same Corporation is erecting shortly a factory at Spalding, Lincolnshire, while the Anglo-Dutch group have a factory projected at Ely. The above mentioned factories, plus those at Kelham, Cantley and Colwick, will bring the total up to at least six factories, all of which, it may be assumed, will if possible be in operation for the 1925-26 campaign.

Fifty Years Ago.

From the "Sugar Cane," December, 1874.

Discussion as to whether it was profitable or not to trash the cane had been taking place at this time, and in reply to a writer named **Thomas Scott**, who had pronounced his view[1] of the procedure as being "both unnecessary and injurious," **R. E. Burton** made the following statement in this issue of our predecessor: "Canes should be trashed each and every time the piece can be weeded. Could this be done every week, so much the better . . . . Green trash should never be torn from the cane. But once the canes are thick enough and long enough to settle themselves down generally, the less they are touched the better they will yield per acre in sugar. This conviction is the result of a good many years' practice, though, of course, other planters may have reasoned otherwise."

There was a report in this issue of some experiments carried out in Barbados with the object of demonstrating the value of Russell's maceration scheme,[2] which was described as "a mechanical process for extracting additional cane-juice by means of maceration and second crushing." His scheme included the use of two mills separated by a long carrier in which maceration took place, the dilute juice being also returned. According to the figures given in the report, the extraction with dry crushing was about 64 per cent., whereas the application of the maceration process raised it to about 83 per cent. (sucrose in the juice per cent. sucrose in the cane). This method of working also provided for the separate defecation of the last mill juice, and was considered at the time very advanced practice.

Two chemical papers which were published in this number may be noticed. Dr. **J. M. Milne**, of Glasgow, described analytical work carried out by him showing that in clarifying sugar solutions with basic lead acetate for the elimination of non-sugar reducing bodies, previous to the determination of reducing sugars by Fehling's solution, the "fruit sugar" was diminished (being 3·27 per cent., compared with 4·90 originally). He considered that a better method of operating was first to filter off insoluble matter, and then, after washing, to treat the filtrate with a minimum quantity of basic lead acetate. It is now known that this procedure does not eliminate the error indicated. **Robert F. Smith** gave his reason for believing that the sulphide in animal charcoal is present mainly as the ferrous compound, and not as calcium sulphide. He explained that the latter compound is decomposed easily by acetic acid and the former is not affected, and that in the case of char no solution of H_2S occurs under the treatment indicated. Calcium sulphide he believed to be present in new char only in very small amount.

Lastly, the chemist, **Anthon**, made his contribution to the theories of that day on the formation of molasses. His view was that salts were less important as molasses-formers than organic non-sugars; that any salt might act positively or negatively in forming molasses, according to the amount present; and that molasses is a saturated solution from which the excess of sugar was prevented from crystallizing owing to the viscosity of the material.

Paradichlorbenzene is reported to have given very satisfactory results as a fumigant against cane grubs in Australia. The cost of the chemical for the treatment of an acre with ½ oz. injections, 18 in. apart on each side of the cane rows, is estimated not to exceed £2.

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[1] *I.S.J.*, 1923, 623. [2] English Patent, 4094 of 1874.

The Reclamation of Abandoned Soils in Cuba.[1]

It is a commonplace that the cultivation of the sugar cane lands in Cuba has suffered greatly in the past because of their very richness. The soil has had a prolonged fallow, if indeed it was at one time all cultivated by the peaceful Indian tribe of Arrawaks, who were found when the island was first discovered by COLUMBUS raising large crops of tobacco and cotton. Not until American capital began to pour in and great factories to appear was there any attempt to exploit large stretches in the eastern half; and, there being plenty of virgin land which was capable with the minimum of attention to produce many years of ratoons, systematic agriculture was not a pressing matter. In the paper under review, the author discusses the well-known statement that "in parts of Camaguey and over the whole of Oriente, besides to a less extent in other parts of Cuba, there are thousands of caballerias (3⅓ acres each) generally referred to by the layman as 'worn out'"; and, being evidently possessed of inside knowledge, he shows that this is by no means a correct description of these lands, and gives a detailed summary of the methods to be adopted for utilizing them again for sugar production.

He refers to the fact that at one time these lands were covered by more or less luxuriant forests; these were felled and burnt, and the land planted with sugar cane in the most crude and careless manner. Burning was the only preparation given to the land before planting, and the condition of the land at that stage is vividly described. The humus had been to great extent destroyed by the fire; and masses of wood ashes covered the ground thickly, with all the normal mineral food required by the plant in an easily available form; the ground was hard, the top layer being baked, flat and unaërated, and underlain by an impermeable subsoil, always waterlogged after rains and drying out afterwards. These lands are usually clays of various degrees of heaviness, but after burning are always classed under the expressive term of "hogwallows."

Into this sticky soil holes were prodded with a sharp stick or pick, and pieces of cane with two to ten eyes, totally unselected, were pushed in; that was all. Apparently heavy crops were produced at first, probably because of the large quantity of wood ashes, but this did not last long. Year by year diminishing returns were noted and, sooner or later, the land became unprofitable, was classed as worn out, and abandoned. Although in some cases this stage was only reached after a number of years, others occurred when after four years no further crops were reaped. In reality, the author observes, the land was in many cases by no means worked out, that being only the case around the original hole in which the cane was planted; it was still virgin land in the true sense of the term, and only needed to be ploughed and cultivated for the masses of stored food to be unlocked. If sufficient moisture still remained in it, or was made available by the conservation of the rainfall, this food immediately became available, as soon as good tilth could be obtained.

The proper method of treating such soil is very carefully gone into; and it is shown that, while the agricultural principles are extremely simple, i.e., removal of the stumps and deeper roots, ploughing and then cultivation with lighter implements, the actual mechanical practice is complicated by a number of factors. Thus ploughing itself turns out not to be as easy as expected, and a great deal of preparation, such as breaking up, levelling, weathering and draining, has to be done before it is profitable or possible. The shares *will not* scour in these heavy lands, and therefore will not plough, and discs do not plough in the proper sense. Even with discs accurate knowledge of their action is needed to prevent their ruining the texture of the soil. As this class of reclamation must be done on a large scale to meet the heavy overhead charges, it is almost impossible to get all the work done at the right time as to moisture content. At first the soil may be too moist, then as it dries the optimum is approached, and afterwards it becomes too dry; and the period during which it is in optimum condition for working is liable to be extremely short (as has been noted by the writer of this article in another set of circumstances), only a day or two or indeed often only a few hours. If the breaking up is attempted when the soil is too moist, it is disastrous to the physical condition, and it may sometimes take a number of years to remedy this, if at all. The author is thus driven to the inevitable conclusion that it is best to commence as soon as the optimum is reached and continue afterwards, as well as may be, when the soil is really too dry.

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[1] Abandoned Virgin Soils in Cuba. J. R. ZELL. El Conde estate, Hershey, Habana, Cuba. *Louisiana Planter* Reference Book, July, 1924.

Proper breaking up of hogwallow lands cannot be done all at once, the higher parts being sliced too deep and the low places too shallow, if they are not largely missed altogether. The first breaking thus becomes in effect a preliminary levelling of the land, great cakes of hardened crust being left on the surface. Cutting up these does no good at all, for every piece must be weathered to its centre. When this weathering is completed a disc harrow may be run over, for a short time after light showers and for a long time after heavier; and the soil will then disc down in a good shape. A heavy drag may be used to level the land down, and as soon as this is done it may be disced again. This will produce an even surface, more or less broken although very unevenly, but with a large proportion of well dried, well weathered and pulverized soil, which will act as a dust mulch to maintain the deep moisture. Ploughing may now be done and, because of the mulch, the optimum condition for this work lies between rather wide limits; the land will remain not too wet and not too dry for quite a time, and the ploughing may therefore be done more at the convenience of the cultivator. After the first ploughing it is advisable to fallow for from two to four months, the well known objections against long fallowing in the tropics not applying to this stage. The land will then disc down to a more or less mellow soil, and maintain that condition for a number of years if not permanently, provided that it is properly attended to.

As soon as this final discing is done, and before rain comes, the land must be drained by ditching. The distances given by the author are one for every 300 ft. across the slope to prevent the water accumulating in low places, and one in 350 ft. down the slope to carry off the water collected to the lowest part of the land, where it may be discharged. Such drains may be cheaply and quickly made by a Martin's ditcher or any similar implement, and they will not interfere with any of the subsequent agricultural operations. The water holding capacity of the soil is high, and if its moisture is not wasted by foolish carelessness in weeding or in maintaining a proper dust mulch, it will never dry out sufficiently to retard the growth of the cane plants, while there is a good enough insurance also against waterlogging.

Land in such a condition may be planted at any time, excepting after rain, light or heavy; as great care must now be taken not to touch it when wet or even too moist. The author states that planting is possible with certain results even in the heart of the dry weather. The seed should of course be carefully selected, and he favours vigorous canes six to eight months old, rejecting the butts and, of course, every piece with a trace of disease; too much care cannot be taken in this matter where there is chance of long ratooning. Width of rows and distances in the row he leaves to the local custom of the planter, as affecting the yield aimed at; but remarks that "very deep planting, slightly covering with soil and gradually throwing earth to the canes as they develop, is considered essential for the best results." Such lands, long regarded as barren, will produce heavy crops at once when put into condition; but the dust mulch must be thick, even to six inches, and the land kept perfectly clear of all vegetation not cane.

The methods here set forth are acknowledged to be costly, but the author claims that they are not really more so for production than those at present in vogue. Many mills are at present working only at 40 to 60 per cent. of their capacity, while all the time they have potentially large crops at their very doors. Sugar, he points out, is made in the field and not in the factory; the so-called "manufacture" is merely the extraction of the sugar made by the plant, and rendering it available in a form convenient for commerce. All the current excuses or explanations for poor crops, wet years, dry years, bad luck, and so on, merely show that the brains are concentrated in the factory instead of the field where the best men should be employed. He then gives instances of the yields obtained after reclaiming worn out lands with the precautions he advocates, varying from 40 to 60 tons of cane per acre.

The author concludes this long and interesting, though sometimes rather involved, article with a few general remarks. "This method never fails, because it cannot . . . . There is no application of manure, no irrigation, no soil amendment . . . . It should only, however, be attempted by those who are qualified to know when a soil *is* worn out and when it *is not* worn out, and why . . . ."; and he quotes HILGARD earlier in the paper very appositely in support of the latter contention.

C.A.B.

Mauritius.

Department of Agriculture Report for 1923.

The Annual Report of the Department of Agriculture of Mauritius for the year 1923, as prepared by Dr. H. TEMPANY, the Director of Agriculture, has just been issued. As usual the sugar industry is fully dealt with in its pages, and what follows is taken—slightly abridged—from Dr. Tempany's report

Agricultural conditions.—Weather conditions were exceptionally unfavourable during the growing season of 1923, and had it not been for the unusually and unexpectedly favourable weather experienced in April and May, the crop harvested would probably have been one of the lowest on record. Those earlier unfavourable weather conditions told heavily on small Indian planters, especially on those whose methods and standard of cultivation are low. In some localities reductions of 50 to 75 per cent. of the normal were experienced on small planters' canes while estate canes of the same regions showed only 20 to 30 per cent. diminution.

The final estimate of the 1923 crop amounted to 203,000 metric tons of sugar, as compared with 231,190 tons in 1922, 197,420 tons in 1921, 259,870 tons in 1920, and 235,190 tons in 1919.

Yield of vesou sugar.—Of the estimated total of 203,000 tons, 98 per cent. will, it is anticipated, consist of *vesou* sugar; the percentage in the previous four years was 97·20, 95·98, 95·46 and 94·45 respectively. In 1914 it was only 82·01 per cent.

Factory work.—The average extraction of sugar per cent. canes was, as anticipated, somewhat low in 1923 on account of the unfavourable weather conditions experienced. The general figure for the whole island is estimated at 10·47, as compared with 10·58, 9·90, 10·76, and 10·42 respectively for the previous four years.

Factory conditions in 1923.—During the year 1923, there has been little actual change as regards equipment of sugar factories, but modifications in processes of manufacture have been extensively tried and improvements in factory buildings commenced in previous years have been completed. Formerly the average Mauritian factory was badly housed and badly arranged; thanks however to the efforts made during the past few years, the general style and arrangement of the factory buildings show a marked improvement.

At the same time considerable efforts have been made to improve the quality of the sugar turned out. Of new processes tried, special mention should be made of the introduction of the Bach process at Highlands Factory, while in several others the use of phosphoric acid compounds on a large scale has been extended. The sulphuring of syrups has also been tried on a small scale with considerable success. Philippe filters are coming into favour and have been installed in several factories while one factory has experimented on some scale with the Thomas and Petree process. In certain factories in the north of the Island the quality of the waters available for use in boilers is defective, and one factory has established an apparatus for softening its boiler feed water.

Area under cultivation.—At the end of 1922 it was estimated that the area under cultivation was 166,400 arpents (173,000 acres); this is a decrease of 5960 arpents over the figures for 1921. The decrease for the most part represents lands which either from their poor character, elevation, or remoteness from factories, could not be cultivated economically in cane under ordinary conditions, and had merely been placed under cultivation owing to the high prices for sugar which prevailed in 1919 and 1920; it also represents a certain area normally devoted to vegetable cultivation which had gone under cane in consequence of the temptations of more profitable returns. With the return to more normal conditions these lands have once more gone out of cane cultivation.

The total area cultivated under cane has probably attained somewhere about the maximum possible under existing conditions, and the only extensions that can be looked for will be due to the increase of either transport or irrigation facilities which may result in opening up a few remote or extremely dry areas where cane cultivation cannot at present be economically practised.

During 1923 but little change took place in the total area cultivated and at the end of the year the probable area under cane is estimated at approximately 167,000 arpents, more exact figures not yet being available.

Indian cultivation.—At the end of 1922 the area cultivated in cane by Indian planters was estimated to be 76,850 arpents, i.e., 46·2 per cent. of the total area under cane.

Conditions affecting the sugar industry.—The main economic factor affecting the sugar industry during the year was the revision of the labour law, which involved the termination of all contracts of engagements on estates, and the resumption, on a limited scale, of immigration from India. These developments took place as the result of a series of negotiations with the Indian Government which had lasted for several years, and, as a result thereof, in January, 1923, a deputation, consisting of the Protector of Immigrants and representatives of the agricultural interests of the island, proceeded to India, with a view to discussing with the Government the possibility of the resumption of Indian immigration on a restricted scale and under revised conditions. As the result of the negotiations which then took place, an agreement was arrived at whereby the resumption of immigration was arranged for, and the first consignment of immigrants under the new scheme arrived in the island on the 5th of December, consisting of 556 persons including 108 women, 73 boys, 48 girls and 11 infants. Of the total number imported, 253 were distributed to estates while 63 were retained by the Government for work especially in connexion with Sanitary services.

Under the terms of the arrangement where immigration was resumed the colonial labour law was modified by Ordinance No. 12 of 1922 which abolished all contracts of engagements by indenture on estates and the concomitant penal clauses. This ordinance came into operation on 8th May, 1922; at the outset fears were entertained that this drastic modification in labour conditions would seriously hamper agricultural operations, particularly during the crop period. These fears however to a large extent proved groundless, and with the exception of a few local and short lived strikes on estates, the labour situation was, if anything, slightly easier than last year. The effects of the introduction of new labour cannot yet be said to be greatly in evidence owing to the short time which has elapsed since the re-introduction of labourers began.

Mechanical cultivator.—Apart from these modifications in labour conditions, the extension of the employment of tractors and implements in the field has continued; there is no doubt that the advance which is to be recorded in this direction constitutes one of the most important events in the history of local agriculture of recent years and is having a very perceptible effect on the labour situation. At the end of 1922 there were 47 tractors at work in the Colony, while at the end of 1923 this figure had risen to 135. Continued interest was evoked in the question of finding suitable implements for cultural operations. As the result it appears moderately clear that for general ploughing, comprising particularly the uprooting of cane stools and the breaking up of new land, by far the most suitable implement for Mauritius conditions is the two or three-gang Disc Plough, while for the preparation of furrows, the implement ordinarily employed is some form of the double Mould-Board Plough.

At present, interest centres particularly in this direction in finding some form of plough which will leave a square-sided furrow; the ordinary forms of double mould-board plough give a furrow which is V-shaped and has to be cleaned out by hand in order to obtain the square-sided flat-bottomed form of furrow that is preferred locally for cane planting. If a plough making a square-sided furrow can be produced it will effect a very considerable saving in labour.

In relation to cultivators, the search for implements which will do satisfactory work continues; a considerable number of new forms of cultivators have been introduced; as the result of the notes on this point published in the last two reports, several firms have made inquiries as to the possibility of supplying implements suitable for work locally.

The Daniel cultivator alluded to in previous reports still continues to hold the field. This implement consists of a frame mounted on four heavy wheels, and provided with three tines of heavy construction, made of wrought-steel which resists the wearing action of the gravelly types of soil so frequently met with.

For working in the interlines of growing canes, cattle are employed to a considerable extent for hauling implements; a number of tractors have also been tried and their use in this connexion is extending. That which gives the most satisfactory results is the small size Cletrac, which does admirable work in virgin canes and up to second and third ratoons. The spread of the stools in ratoons of a higher order than this, however, militates to some extent against its employment, as the tractor track tends to damage the young shoots.

Irrigation of sugar canes.—The area under irrigation in sugar canes in the Black River district of Mauritius from the La Ferme reservoir was estimated to be about 3000 acres during 1923. Work on the La Nicolière scheme continues to make favourable progress, and it is hoped that by the end of 1924, the first reservoir at La Nicolière itself may have become sufficiently complete to enable a certain amount of water to be delivered therefrom. Work on the second and larger reservoir at Midlands was commenced during the year.

The experiment station for the investigation of irrigation problems at Médine came into full working order during the year. This station is intended to solve a number of problems concerned with the irrigation of cane in Mauritius, and results have already begun to come to hand; they will be included in a complete report on the work when they are sufficiently far advanced to enable definite conclusions to be drawn. In the meantime, a number of points emerge which are of importance, chief among these being the very great loss of water that takes place owing to seepage in channels and distributaries. There is no doubt that this constitutes one of the most serious factors requiring consideration in connexion with irrigation in Mauritius, since in some cases in porous ground the losses sustained in this way may amount to 50 per cent. or more of the total volume.

It is interesting to record that similar conclusions have been arrived at in Hawaii, as evidenced by a report recently issued by the Hawaiian Sugar Planters Experiment Station in which the question is reviewed. It is further evident that considerable losses of water take place owing to uneconomical methods of application, while in relation to cane returns it seems clear that the season of planting is of great importance.

Disposal of the sugar crop.—The Sugar Planters' Syndicate continued operations during the year, and there seems no reason to doubt that it has become established as a permanent feature in the economy of the sugar industry and is one which has greatly improved the conditions under which Mauritius sugars are marketed. The mean prices at which the 1920-23 crop were sold are as follows:—

1920-21	Rs. 50·68 per 50 kilos
1921-22	12·05 ,,
1922-23	13·86 ,,

The sugar market for the 1923-24 crop firmed up very considerably and although final figures are not available, it is estimated that the average price will approximate to Rs. 18·85 net per 50 kilos.

Of the 1922-23 crop the bulk was exported to the United Kingdom. Since the war the tendency has been for Mauritius sugars to find their way on to the European market, rather than to the Indian market where formerly the bulk of the crop was exported, this being the direct outcome of the preference received by Mauritius sugar in the English market.

Pests and diseases of the sugar cane.—The principal enemy of the sugar cane has continued to be *Phytalus smithi* and the campaign for its control was continued on lines followed in previous years, the cost being provided for by means of the special tax of 20 cents per ton of sugar exported which is levied for the purpose.

The total number of insects destroyed (43,452,000) exceeds that of the previous year by some 18,000,000. The infection is now practically confined to two points in the infected area; it is by no means clear why the prevalence of the beetle has shown such a marked increase during the year 1922-23, and it is possible that some factor is at work, the existence of which has not yet been recognized; this point is receiving investigation. Other pests and diseases have not been evidenced to any important extent.

Experimental investigations in relation to the sugar industry.—The appointment of a Botanist and a Sugar Technologist to the staff of the Department of Agriculture has enabled the investigations in progress to be considerably extended while the current work has been maintained. The extensive series of experiments with varieties of sugar cane have been continued, and the average results obtained from the work for the past six years have been prepared for publication. As the result of the work that has been done a number of proved varieties have been placed in the hands of planters, and there is no reason to apprehend danger from the breaking down of existing standard varieties inasmuch as a good selection is available to replace them if required.

Work in relation to manurial requirements of cane has been steadily extended; the work in progress includes trials with natural and artificial manures, and also experiments with ploughing, cultivation and green dressings. The conclusions arrived at as the result of these experiments will in due course be summarized and published.

In the meantime results available indicate that there may be some foundation for the idea that manuring with artificial manures in addition to the applications of heavy dressings of organic manures may in some cases be overdone, and that to some extent the heavy dressings of artificials often applied are not always productive of corresponding increases. An elaborate series of experiments on the application ot molasses to soils has been carried to a conclusion, the results of which corroborate the belief in the benefits to be derived from this process, and indicate that the increases observed are due to a variety of superimposed factors and not, as was formerly supposed, entirely to the stimulation of free living nitrogen-fixing organisms.

A series of investigations have been carried out on the growth of the sugar cane with special reference to the development of the young shoot from the planted cutting. The newly established Botanical Division has taken up work on the measurement of the growth of canes and on the transpiration ratio of cane with special reference to the water requirement of the plant. Experiments have also been started on selection of canes on account of vegetative vigour, following the lines laid down by A. D. SHAMEL, this work being carried out by the Sugar Technologist and the Botanist in collaboration.

In relation to Sugar Technology an investigation of the Bach process of clarification has been undertaken in conjunction with the authorities of the factory in which it has been installed. An investigation was also begun into the causes of pollution of rivers by sugar factory waters by the Sugar Technologist in co-operation with the authorities of the Bacteriological Laboratory. In relation to the teaching of Sugar Technology, the Sugar Technologist is engaged in working out a series of Laboratory Exercises designed to illustrate various reactions and processes in the manufacture of sugar.

In addition to the above, reference has already been made to the important series of investigations taking place at Médine in relation to the irrigation of canes. Furthermore, mention should also be made of experiments that are being carried out by private companies on the possibility of producing *fumier* from cane straw and bagasse by the method of inoculation that has been worked out by the Rothamsted Experiment Station.

The Natal Sugar Industry.

(Department of Overseas Trade Report[1]).

In 1923 the area under cane was 211,000 acres, extending along the coastal strip of Natal and part of Zululand from Port Shepstone on the south to Umfolzi on the north, a distance of some 230 miles. Cane takes two years to mature, which means that in order to produce an assumed output of sugar it is necessary to keep twice the area under cane that would be required in some countries, where the cane matures every year. The tonnage per acre in Natal and Zululand varies between 20 and 40 tons. Cane has suffered badly for the last three years through drought, which has detrimentally affected the output and reduced the yield per acre. No cane is grown under irrigation.

There are 27 factories in operation, 17 of which cultivate a large proportion of the cane crushed ; this is supplemented by cane purchased from independent sources. The remaining 10 factories are central mills, which crush cane purchased solely from independent cane planters. One of the two refineries in existence is closed down at present, but is expected to re-open during the course of the coming season.

The crushing season opens each year in May and closes in January. The manufacture of sugar for the 1923-24 season reached the record total of 203,360 tons as compared with 92,153 tons ten years earlier, and 180,000 tons, in 1919-20, which is the nearest approach to the latest figures. The record production is due not only to increased plantings but also to the ruling high price of sugar during the season, which influenced cane farmers to reap crops that would in ordinary circumstances have been cut during the earlier part of the 1924-25 season.

Sugar consumption in the Union of South Africa and Rhodesia is approximately 145,000 tons per annum, and production in excess of this quantity must eventually be exported. The total export to Great Britain for last season was 28,500 tons.

The local price of first refined sugar for the year ending 30th April, 1924, fluctuated between £25 and £35 per ton, and has since dropped to £27 10s. per ton.

The sugar industry is protected by an import duty of £3 10s. per ton of 2000 lbs., with an additional duty of £1 per ton to cover the present excise duty of the same amount, payable to the South African Government on each ton of sugar produced.

The industry has grown from very small beginnings, and has now become one of the most prosperous industries in the country. Fresh capital is being invested in many of the mills with the object of installing more modern equipment. New areas are being opened up and established areas are being more intensively cultivated; and a notable instance of the expansion of the industry is to be seen in the Eshowe district of Zululand, where cane growing has recently been started.

In 1919-20 the high price of labour caused a certain number of planters in Java to purchase tractors, and motor-driven ploughs ; but this movement has not developed, C. E. VAN DER ZYL[2] states, now that wages have fallen again, the tractors then introduced at present are in use mostly for ridging. Whereas machine ploughing and ridging costs 236·25 Dutch florins per bouw, ox ploughing and hand ridging costs only 155·32 on the same basis. High cost of motor fuel, rapid depreciation of the machines, and heavy rate of interest on capital are given as the contributing factors for this retrogression.

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[1] Written by Mr. D. STRACHAN, I.T.C., July, 1924.

[2] *Archief*, 1924, 32, No. 9, 269-317.

Simple Contrivances for studying Root Development in Field Crops.[1]

By T. S. VENKATRAMAN, B.A.,
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R. THOMAS,
Botany Assistant.

INTRODUCTION.

That roots of plants—those of agricultural crops in particular—need a careful study is now well recognized, thanks to the marked attention paid to the subject in recent years. Unlike the above ground portions of the plant, whose development and growth can continuously be watched, the roots are hidden from such observation by the opaque soil in which they develop and function. No apology, we believe, is therefore needed for placing before this Congress certain methods which have been found useful in a study of the root development of sugar cane varieties and seedlings. The methods, though employed by us solely in connexion with cane, are capable of being applied to other crops as well with necessary modifications.

METHOD FOR STUDYING RELATIVE DEPTH AND PLAN OF ROOT DEVELOPMENT.

(a) *The Apparatus.*

Rings of country earthenware, 1 ft. 6 in. in diam. and 6 in. high, are obtained. Any village potter will be able to make them—at Coimbatore they are available at Rs. 12 a hundred. Two-inch galvanized wire netting is cut into squares, the side of the square being about 3 in. longer than the diameter of the earthen rings.

Trenches are dug in the soil, their breadth about twice the diameter of the rings and the depth a little over the maximum depth of the roots of the plant, at the stage in which it is intended to examine them; the latter is easily ascertained by a few rough dissections in the field.

An earthenware ring is now placed at the bottom of the trench and filled with soil to the top, carefully compacting it by watering at intervals during the filling. A cut piece of netting is then laid flat over the top of the ring. A second ring is next placed over the first and similarly filled with soil. The process is repeated till the earth is filled to the top with the column of rings. Each trench receives many such columns and, when all the columns have been filled with soil, the vacant spaces outside and between rings are filled with soil.

A set of the cane variety, whose root system is under study, is now fastened either to a layer of netting placed on the top of the topmost ring or to a piece of galvanized wire stretched across it; the former procedure is adopted when it is desired to follow the root development from the earliest stages.

The pot-filled trenches are subsequently cultivated on the surface like any other trench in a sugar cane field in the matter of irrigation and manuring.

(b) *Examination of the Roots.*

For examining the roots, the soil all round the earthen rings is scooped out, planking inserted below the lowest ring in each column, and each column, with the plant inside of it, bodily lifted out of the trench. These are now taken to a place nearby where water can easily be commanded and a stream laid on to the topmost ring. The soil inside the rings can now be washed out with comparative ease by removing the bottom planking and assisting the stream of water in its work by poking the soil with bamboo sticks.

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[1] **Paper read at the Botanical Section of the Indian Science Congress, Bangalore, 1924.**
***Agr. Journ. India*, XIX, 509–514.**

Each column is separately placed in the centre of a bamboo or wooden frame 4 ft. × 4 ft. × 4 ft. The edges of the netting, chiefly the corners, are fastened to the frame as tightly as possible. It will be found that the end rings can now be slipped off without any disturbance to the roots. The rings caught between layers of netting are broken—though after some experience even these can be saved for future use by temporarily unfastening the holding strands and infolding the netting while slipping the rings off. The whole root system of the plant will be found fully exposed with the roots caught up in their original positions or very near them.

For greater accuracy and for thinner roots, half-inch netting and finely sifted soil for filling the rings are recommended. The dimensions of rings given above have been found adequate for following root development in canes up to a period of about three months from germination; for more advanced stages wider rings will be needed.

(c) *Uses and Advantages.*

(1) By laying down a sufficient number of columns it is possible to follow root development from stage to stage. For this purpose half a dozen to a dozen plants of the same variety and of the same age are lifted out for examination at definite intervals, say, once a fortnight. The reason for examining more than one plant at a particular stage is to rule out individual variations.

(2) The method is fairly fool-proof, as the arrangement ensures the roots being caught automatically in their original positions in the soil or very near them.

(3) After fixing to the frame, the root system lends itself very easily to photography—a rather important condition for the accurate recording of root development at successive stages.

(4) The method makes possible the study of the effect of different soils on the roots of one and the same plant. This is done by arranging, adjacent to each other, two columns of rings and filling them with different kinds of soils. The cane set is placed at the top between the two columns, and half of the roots are allowed to develop in each. Effect of different irrigation waters could also be similarly studied.

The above method has one disadvantage, however, in that the soil in the bottom rings may not be quite representative of the subsoil in the ground, chiefly in texture. But against this it may be mentioned that, in a study of root systems of field crops, the top layers of soil are of greater importance. While filling the rings we have attempted to simulate conditions in nature, by keeping separate the different layers of soil as they are removed from the trenches, filling the rings back in the same order and carefully compacting the soil layers as the rings are laid.

METHOD FOR CONTINUOUSLY WATCHING ROOT DEVELOPMENT—CULTURE SOLUTION IN CHEAP EARTHEN COOKING POTS.

The first method, though useful for recording root development at definite periods, is not suitable when, for any reason, a continuous observation of the roots as they develop is desired; the mass of opaque soil prevents such an observation being made. This was found a disadvantage of considerable magnitude when studying the early developmental stages in the cane. A different method had to be devised for the purpose.

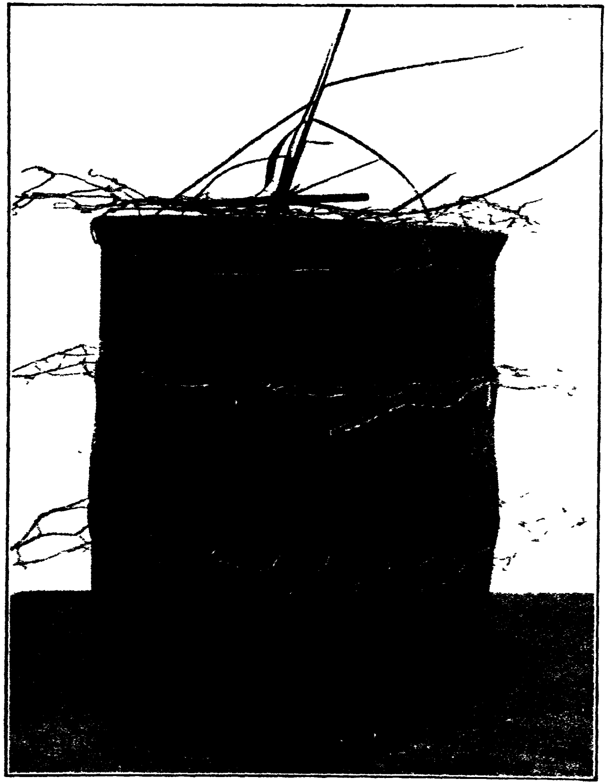

FIG. 1

A column of three rings as taken out of the trench for the examination of the root system.

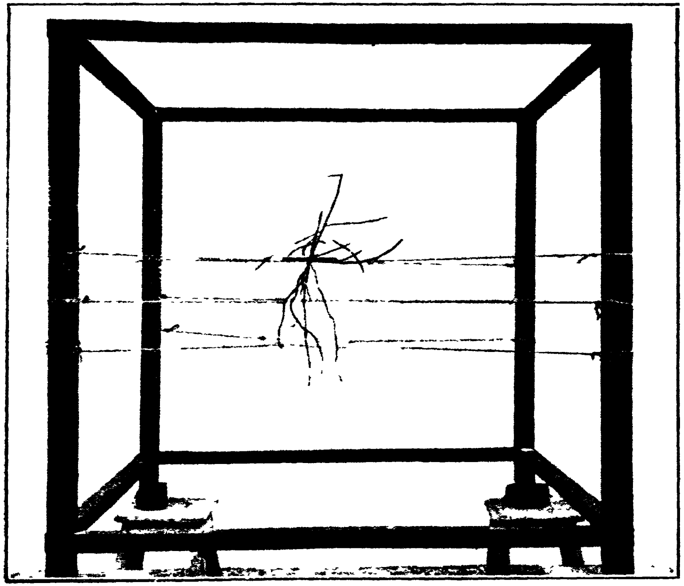

FIG. 2

The earthenware rings and the soil removed in the same specimen. The plant remains with the wire netting which keeps its roots in position

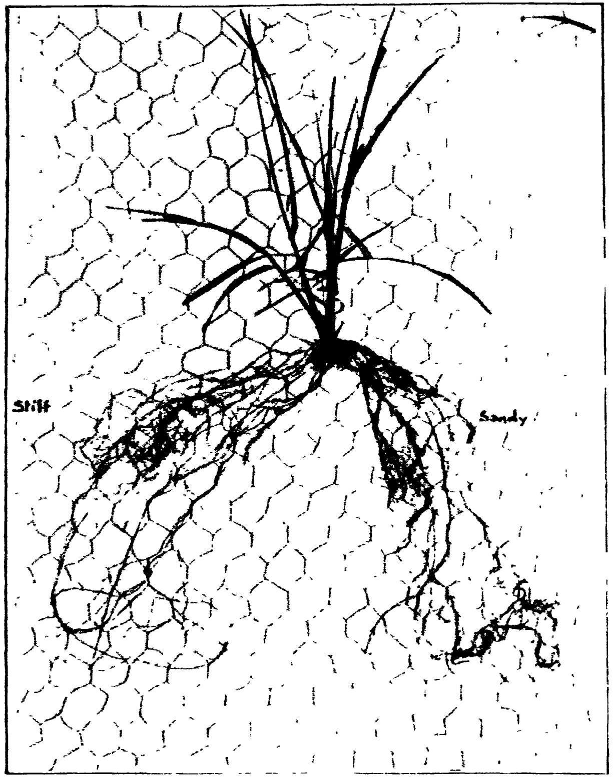

Fig 3
A cane plant with its roots grown in two different types of soil

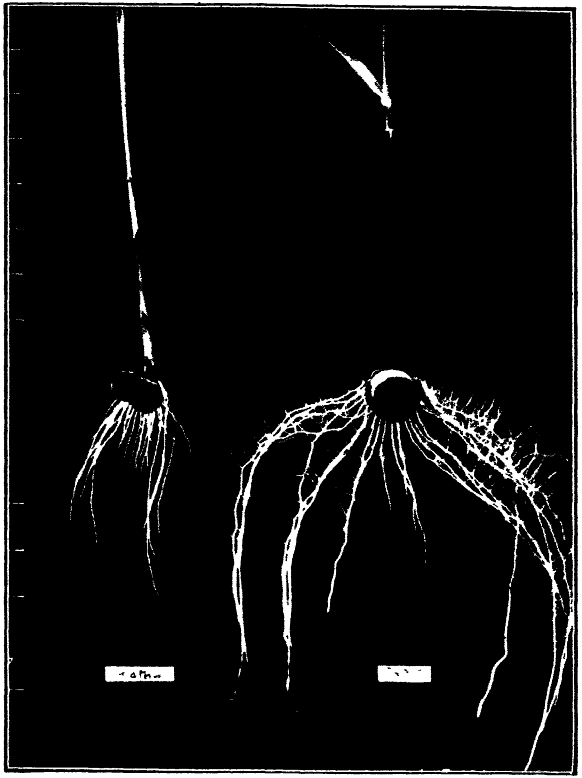

Fig. 4
Comparative root development of Katha and Co. 210, three weeks from planting in dilute culture solutions.

(a) *The Apparatus.*

Ordinary country earthenware cooking pots—available in village bazaars at Rs. 6 to Rs. 20 a hundred according to size—are employed. The cane set, whose root development it is intended to study, is suspended in the pot by a pair of glass bangles[1] from a piece of bamboo laid across the mouth of the pot.

The pots are filled with dilute culture solution—we have been using Knop's, but any other might do equally well—till it covers the suspended set excepting the bud. For sugar cane plain water has been found to serve the purpose during the very early stages. The culture solution is renewed when it begins to smell.

The pots with the suspended sets are now arranged in batches according to the variety in the field, the mouths being covered by suitable lids with a hole in the centre for the shoots to grow through. The cane plants develop and grow quite freely in such pots, and we have this day plants over seven months old with fully formed canes.

(b) *Uses and Advantages.*

(1) The articles of apparatus used are cheap and available in most places, two factors which facilitate the laying down of the experiment on a large scale. The growing of a large number of plants is necessary for arriving at satisfactory averages. Costly glass jars or glazed earthenware vessels are not only unnecessary but interfere with the aeration of the culture solutions.

(2) The porous earthenware provides for a free exchange of gases between the solutions and the outside air; in fact, it is found that pouring the solution slowly into another pot and pouring it back each evening is all that is needed by way of aeration of the solution.

(3) The evaporation from the surface of the pot—resulting from its porous nature—prevents the solution inside the culture pot from getting to a higher temperature than desirable for a satisfactory root development, a common trouble when plants are grown in glass receptacles placed above ground.

(4) The method enables the examination of the roots to be made from day to day and from morning to evening. As the result of such continuous observation—unavailable in any other method—certain important differences in the evolution of the root systems of different cane varieties have been revealed. One such is the close correlation that has been revealed between the shoot roots of a germinating sugar cane set and the health, vigour and tillering of the particular plant.

(5) The method enables the attainment of reliable data on the quantity of roots developed; when specimens for weighing have to be obtained from plants grown in the soil, there is always the risk of losing small bits of roots during the washing.

(6) Barring modifications resulting from the roots being grown in liquid media, the process has facilitated the study of different functional regions of one and the same root—from the root cap to the old branching and conducting regions.

(7) The method promises to be useful for studying the development of root hairs. This is done by placing in the solution test tubes filled with glass or pebble sand and allowing one or more of the roots to grow in them.

Mr. ARNOLD H. WARREN[2] gives the following figures for production costs in the P.I. in cents per lb.:—Transportation of cane, 0·32; manufacture, 0·33; and administration and general expense, 0·22, a total of $0·87.

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[1] The bangles (bracelets) used are of the kind available in most Indian bazaars at Rs. 2 a hundred and are of the type usually worn by Indian girls.

[2] *Facts about Sugar*, 1924, 19, No. 17, 393.

Selected Coimbatore Canes in Growers' Fields in North Bihar.[1]

By WYNNE SAYER, B.A.,
Secretary, Sugar Bureau.

It has been mentioned in a previous article by the present writer on "Mill Trials of Selected Coimbatore Seedling Canes," published in the *Agricultural Journal of India* (Vol. XVIII, Part III),[2] that, as a result of thorough testing at Pusa, three seedlings, viz., Co 210, Co 213 and Co 214, were found to be superior to the canes grown in North Bihar, not only as regards tonnage and improved sucrose content, but also in their practical freedom from disease when grown as field crops. It was also reported in that article that, as soon as the mill trials were found satisfactory, a large demand for these canes came in from the growers in Bihar, but as the supply of seed-cane was very limited, only the available quantity of these three varieties was distributed in February, 1923. In distributing these canes care was taken to select growers from as many districts in the White Sugar Tract as possible, viz., Monghyr, Darbhanga, Muzaffarpur, Champaran, Saran and Gorakhpur, with a view to find out how these three canes behave under different soil and cultural conditions. As most of the growers had not at the time got the implements for planting recommended by the Sugar Bureau, it was considered worth observing whether, with the methods likely to be adopted at the time by the growers, these canes would still show their superiority over local canes. It may be mentioned that at Pusa, where the soil is not considered to be first class soil for cane-growing, the yields of the three varieties, Co 210, Co 213 and Co 214, in years of normal rainfall have averaged 700, 800 and 600 maunds[3] (i.e., roughly speaking, 25 tons, 29 tons and 22 tons), respectively, of stripped cane per acre, as compared with the 300 maunds (about 11 tons) of *Hemja* or *Bhurli* locally grown.

A circular letter was issued by the Secretary, Sugar Bureau, to the various growers requesting them to report their experience with these canes. Their replies show that almost all were pleased with the results they got. The germination of these canes was excellent, being much earlier and more vigorous than that of the local canes; they started to make a much more vigorous growth and they also stood the hot weather very well. The results would have been much better as regards the final yield if, as the growers say, the monsoon had been normal. As a matter of fact, the whole of North Bihar had in the year 1923 the most deficient rainfall for very many years. It is, however, a matter for satisfaction that even under such adverse conditions the growers were convinced of the superiority shown by these selected Coimbatore seedlings on their own fields planted and grown by their own staff under their own conditions. A valuable asset has thus been created in a body of large growers who have seen for themselves that what is recommended to them by the Sugar Bureau is not only capable of being reproduced on their own fields but of even being improved upon. They are now taking up the improved planting outfit recommended by us and have begun to see the value of improved cultivation and manuring. These are very hopeful signs, and we expect to see solid progress in this direction in the near future.

We will now quote relevant extracts from the letters of some growers as regards the cultural methods adopted and the yields obtained by them.

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[1] Reproduced from the *Agricultural Journal of India*, Vol. XIX, Part V.

[2] See *I.S.J.*, 1924, 584.

[3] 1 maund = 82·28 lbs.

Mr. **Dalrymple Hay**, of Jeetwarpore, near Samastipur (Darbhanga District) gives the yields obtained by him as follows:—

Co 214	560 maunds per *bigha*,[1] over	24 tons per acre.
Co 213	400 ,, ,, ,, ,,	17 ,, ,, ,,
Co 210	740 ,, ,, ,, ,,	32 ,, ,, ,,

He reports that all these varieties were planted in the same quality soil and were given farmyard manure. The low yield of Co 213 was, in his opinion, due to the effect of trees at a short distance on part of the land. The rainfall was only 32·60 inches with no heavy downpour, and moisture was poor. He concludes as follows:—"All these canes are much better than *Bhurli* (local cane) which with same treatment is only cutting out at best 300 maunds."

Mr. G. P. **Danby**, of Bowarrah, District Muzaffarpur, writes to say that *he got 30 tons per acre on an average.* He grew these canes both on light and heavy soil. The land was given a little farmyard manure and in some cases mustard oil-cake at the rate of half a ton per acre. The rainfall was only 24 inches. He concludes his letter with the following observations:—"All the canes did very well, but Co 213 and Co 210 cut out the best, although Co 214 proved itself to be a hardy and healthy cane. All stood the drought exceedingly well."

Mr. C. **Atkins**, Manager, Dowlatpur Agricultural Concern, District Darbhanga, writes that he grew these canes on light sandy soil. The rainfall during the monsoon period was only 18 inches as against the normal of 49. The crop yield obtained was:—

Co 214	300 maunds per acre.
Co 210	375 ,, ,, ,,
Co 213	593 ,, ,, ,,

The following is an extract from the letter dated the 1st March, 1924, of Mr. J. **Hemish Walker**, Cane Superintendent, Ryam Sugar Factory, District Darbhanga:—

"*Tonnage per acre of Coimbatore canes cut.*

"(1) Co 214 .. 21·4 tons per acre.
Co 213 .. 29·0 ,, ,, ,,
Co 210 .. 19·3 ,, ,, ,,

"(2) Co 214 in sandy soil with patches slightly 'Oosur' (alkaline).
Co 213—average soil—slightly heavier than 214.
Co 210—fairly stiff soil, with a good deal of clay.

"Manure in all cases, 190 lbs. sulphate of ammonia per acre. No other manure given, and land was in poor condition until a month before planting, which was done in October-November, 1922. Crop was kept entirely free from weeds, and when cut, land was clean.

"(3) Condition of crop was good.

"(4) Rainfall for year was 38·33 inches of which 4·50 inches fell on 3rd and 6th October. A regular weekly analysis has been made of each variety from 17th November up to 26th February, and will be continued in the case of Co 213 and Co 214. A complete stool is used in each case, every cane being ground, and an average sample taken for analysis. Results show that canes have improved in quality up-to-date and show no sign of falling off."

Mr. E. J. **Finch**, of Manjhaul Factory, District Monghyr, reports as follows:—

"I have not weighed out my Coimbatore canes, as most of what I had has been used for seed purposes; however, I sent a little of my Co 214 that I did not require to the Samastipur Mill, and it worked out at maunds 376 per acre. The *Bhurli* alongside is only giving maunds 300.

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[1] The *bigha* varies in size in different parts. Here it appears to equal five-sixths of an acre (See below).

"The soil I had these canes in is a sandy one.

"The condition of the crop, considering the year, was quite good. The crop had maunds 15 per *bigha* of *mahwa*-cake (*Bassia latifolia*) applied at time of planting.

"My rainfall was 21 inches, i.e., from the 1st June to 31st October, against my 20-year average of 47 inches."

Mr. H. K. GRAY, of Mia Chapra, District Muzaffarpur, grew these canes on a rainfall of 22 inches. He grew Co 214 in fairly good land and manured it with farmyard manure and got a crop yield of 520 maunds per acre. *His Co 213 was sown in good land manured with castor-cake at the rate of 50 maunds per acre, and the result was an outturn of 1140 maunds cane per acre.* He says: "The results would have been much more favourable had the rainfall been normal."

Mr. E. C. CRANE, Manager, Peruckpore, District Muzaffarpur, reports that he got 500 maunds per bigha (i.e., 600 maunds per acre) from Co 214 and that the condition of the crop was good.

Mr. S. N. BOSE, Manager, Kanti Concern, District Muzaffarpur, reported the condition of the crop good, considering last year's poor rainfall. He was unable to give the tonnage of the canes separately but he said he would be able to plant over 30 acres with these canes.

The Manager, Turcouleah Concern, District Champaran, got approximately 700 maunds cane per acre from Co 213. He applied 20 maunds of castor-cake per acre and regularly irrigated the crop before the break of the monsoon. The rainfall on his estate was only 24 inches.

To summarize: It is clear from these extracts that in spite of the unfavourable monsoon these three Coimbatore seedlings have shown their superiority under similar conditions over the local cane in the growers' own fields. Of these three canes, while each has got its own good points, Co 213 is liked best by the growers and also by the sugar factories as a general utility cane. It is easily the first in tonnage, second in sugar, lowest in fibre but with enough fibre to make it a good all-round factory cane. Consequently there has been a heavy demand for the seed-cane of this variety and 19,000 maunds have been distributed this season. Of the other two varieties, 11,000 maunds of Co 210 and some 6000 maunds of Co 214 have been distributed this February, and it can be said that these canes are now well established in North Bihar. It is most unfortunate that the canes had to be planted this season in a soil with very little moisture, and as cane is not usually irrigated in Bihar even during the hot weather months, these varieties will this year be put to the severest test any cane has to undergo. The results, therefore, of this year's growing will be awaited with considerable interest if not with anxiety, as both the growers and the factory industry believe that with the establishment of these canes in the district the sugar industry in Bihar will rest on a sound basis.

It may here be mentioned that by far the majority of cane-growing countries ratoon canes owing in most cases to scarcity of labour and its consequent cost. In parts of India like Assam and Burma where there is a shortage of labour it is essential that the cane grown should be a good ratooner in order to enable the grower to keep his maximum acreage under cane. In the White Sugar Tract of North India with its dense population and cheap labour it may not be so necessary to keep ratoons, particularly because ratoon cane is far more liable to harbour disease if once it gets introduced in the districts. But considering the fact that labour is an ever rising market, it is none the less desirable to study the ratooning qualities of the canes which are being recommended for adoption by growers. Accordingly, experiments in connexion with the ratooning qualities of Co 214, Co 213 and Co 210 were carried out at Pusa during the year. Here again the exceptional deficiency in the rainfall hampered the obtaining of data applicable to a normal year. It was, however, seen that under such conditions Co 214 and Co 210 can be successfully ratooned. Co 213 with its larger leaves and greater transpiration surface undoubtedly requires more moisture than was forthcoming, and while the other two canes made good progress, the growth of Co 213 was badly checked with the result that about six acres of this cane failed to fill and a large proportion of the cane hollowed out, rendering it unfit for seed or crushing. This cane was on light land, and it is probable, though not definitely proved, that to obtain the best results from such a heavy tonnage cane a minimum rainfall of 40 inches is essential and the cane should go on stronger land than the other two varieties. Co 210 and Co 214 with their smaller leaf area showed no signs of checking, and the hollowing out referred to above did not appear in these varieties. The incidence of fungus disease was almost nil, but considerable leaf dryage was in evidence towards the end of of January, which however did not affect the cane. The yield averaged some 400 maunds of unstripped cane per acre for both Co 214 and Co 210, while Co 213 failed completely.

Further ratooning experiments are being carried out this year with a view to find out whether under normal rainfall these three varieties give higher yields than those recorded above. Questions such as the treatment of the stools and general manuring will also receive attention, as it is necessary to ascertain the profits derivable from ratooning these canes as compared with those obtained from plant cane.[1]

Recent Milling Practice in the Philippines, Hawaii, Australia, and Java.[2]

By WILLIAM WYLIE.

The writer has had the opportunity of experience in four cane growing countries, and the following is in the nature of a comparative report.

Philippine cane is a one-year variety, high in sucrose, and is usually low in fibre content. To the average mill engineer this would appear to be splendid milling cane; but, owing to the high tonnage grinding rate of most of the Centrals, extraction results are lower than in Hawaii.

HAWAIIAN ISLANDS.

The Hawaiian cane variety is a better feeding cane; this the writer attributes to a longer staple fibre content. In the case of our one-year cane, the fibre may record the same percentage but it presents very short tissues. Because of this poor feeding quality, it is difficult to bring our extraction to what we desire; but eventually we may do so by experimenting with surface grooving and juice grooves. As the first move in obtaining this end, our cane carriers must be loaded uniformly and at least two sets of cane knives, or some other preparatory machinery for breaking up the cane sufficiently to assure maceration being effective behind the first mill, must be used. Surface grooving on feed rolls ought to be at least ½ in. pitch, 45° angle, equipped with juice grooves 3 in. pitch and sufficiently deep to completely drain the juice at whatever surface speed of roll the engineer desires to run. The surface grooving of top and discharge rolls should be ⅜ in. pitch, 45° or 60° angle, and discharge rolls should be provided with juice grooves 2 in. or 3 in. pitch, width and depth to suit surface speed of rolls. In other words, the slower the surface speed, the deeper the juice groove, provided a heavy tonnage is desired. The writer also recommends juice grooves on the bottom crusher rolls, similar in size to those used in feed rolls and set about 6 in. pitch. The idea originally was to prevent squirting of juice, especially on the Krajewski type; but it was observed that these grooves greatly improved feeding, and produced a decided increase in extraction.

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[1] Since the above was written, reports have been received from the growers stating that these Coimbatore seedlings, though planted on deficient soil moisture, successfully withstood the hot weather which was exceptionally severe this year and are now far ahead of the local canes. As the monsoon has so far been favourable in this tract, the growers expect a good crop of these seedling canes. [W S.]

[2] Report presented to the Philippine Sugar Association, 1924 Convention.

AUSTRALIA.

Our Australian friends have experienced the same problem of feeding, and they have adopted a grooving ⅜ in. and ½ in. pitch, 30° angle. This, one realizes, is a very sharp angle and evidently makes a splendid feeding mill. Feed and top rolls are equipped with lateral grooves, and in some cases there are juice grooves on feed rolls. They also equip their mills with mechanical feeders, especially in the case of the later units in the train, as choking on the first mills is not experienced. These mechanical feeders, or pushers as they are termed, are usually driven off gearing shafts and seem to be very effective and sturdily built.

Australian mills still stand by the semi-diffusion system of macerating. The machinery consists of two large drums about 5 ft. in diam., equipped with very heavy chain drives and a long partially enclosed fork-shaped conveyor. By means of this device, the bagasse is held in boiling hot water in some cases 12 mins. Another type is a long trough between mill centres about 35 ft. in length, where the bagasse remains in water about the same length of time. With 9 and 12-roll mills the extraction is exceedingly high. But it must be remembered that 50 to 60 per cent. dilution is being added, which not only necessitates burning all the bagasse in sight, but also wood and coal for extra fuel.

JAVA.

The Javan system of milling is somewhat similar to ours. Engineers in that country, however, do not care to use juice grooves, and approve of a coarse grooving throughout, with a low surface speed of roll. The writer particularly noted the Javan system of lateral grooving and scraper adjustment on top rolls. The scraper sets back about ¼ of an inch clear, the bagasse being allowed to cling to surface of top roll. This assures a positive feed, provided the mill is properly adjusted, and the writer cannot recall observing a mill choke.

Occasionally one hears a complaint that roll shells are too hard, causing slippage. Others complain that the material is too soft, causing the roll shells to wear rapidly. This a problem that has been referred to the manufacturers time and again, and naturally they will furnish whatever the customer desires. Rolls of hard texture are not suitable for any class of cane mill unless they are equipped with very coarse grooving, and these can be used only for crushers.

SOME REMARKS ON SLIPPAGE.

Slippage usually brings a complaint of too hard a shell. While this is very true in general, there are several other reasons for this trouble. Overloading the hydraulics will cause slippage and choking, although the mill engineer usually has wisdom enough to avoid this cause. Some claim choking takes place between top and discharge rolls only, and the feed roll is not taken into account. This is entirely wrong. The feed roll is very important should choking be experienced, and one should use coarse groove ⅜ in. or ½ in. pitch on the feed roll, and install lateral grooving across face of roll. Choking will then entirely disappear without doing anything to the discharge roll. During part of the last campaign at Talisay, the feed rolls on the old mill were machined as described above, the result being that five men per shift were done away with, and an additional fifty tons of pressure was applied to the second mill. Lateral grooving is very important and I recommend this system for our Philippine cane, 80 per cent. of which is Negros Purple. This is considered the best quality of cane to mill, but the bagasse on reaching the last mill is of a cabbage-like nature and cannot be compared with Hawaiian bagasse. Likewise H 109, which is a splendid milling cane there, is exactly the reverse here. We are operating under conditions entirely different from those in Hawaii, and the prevention of slippage can only be accomplished by experimenting with surface grooving to suit our conditions. Engineers having trouble with it should first consider the nature of cane being milled and not adhere to any standard mill setting or grooving. Soft roll shells will naturally decrease in diam. faster than hard shells; but nevertheless slippage is one of the chief causes of roll wear, and if the slippage can be prevented in starting out a mill, it is surprising the length of life which can be obtained from rolls of soft texture. The principal arguments in favour of a soft shell, or what is better termed a good, open-grained, grey, cast-iron shell, are the following: Such shells do not polish so rapidly, they are more easily grooved, feed with closer settings, produce lower moisture in bagasse accompanied with higher extraction. In Hawaii a roll shell of the above texture will last four to five seasons on top or discharge rolls; and there each season represents from six to eight months grinding time where we very seldom exceed four and a half months.

Grouping of Rollers, and Maceration.

In all cases it is advisable to avoid grouping together rolls of different diameters. A large-sized top roll incorporated with small feed and discharge rolls is one of the worst combinations possible. In cases where the roll diameters are so reduced that the original roll pinions have no further clearance, it is far better to purchase pinions of a suitable reduced diametrical pitch to suit small shells rather than to cut the original pinion to accomplish this clearance. The life of a shell can be considerably increased in this manner, although the practice is objectionable because it eventually results in a whole train of under-sized rolls.

It is noticeable that our present maceration is very low in comparison with Hawaiian practice. This can be attributed to the higher moisture content and poorer fuel value of our bagasse, which makes steaming difficult. To the Petree process of maceration by returning mud behind the first mill, the writer has one objection. With a 2-roll crusher and a 3-roll mill doing good average work, the sucrose in the bagasse would be about 7 per cent., and with sucrose in returning mud averaging about 11 per cent. the extraction of the succeeding mill will be considerably lowered. This applies especially to a 9-roll train, and is not so noticeable on longer trains. The mere inconvenience of returning mud and other ingredients could be overcome, but the disastrous effect upon extraction of the rich liquid which accompanies the mud is absolutely discouraging. We are installing two Peck strainers for the next campaign and it will be interesting to note the results obtained in comparison with the previous campaign. We anticipate these strainers will be a decided advantage and possibly increase the capacity of our Dorr clarifiers. For the next campaign the juice strainer on both mills will be moved forward to discharge cush-cush in front of the first mill.

Report on the Manufacture of Sugar in the Philippines.[1]

(*A*) By HERBERT WALKER.

CLARIFICATION.

A number of experiments have recently proved that the greatest trouble in refining is caused by a relatively small percentage of semi-colloidal "non settling matter" left in the juice by an imperfect clarification.[2] The Dorr clarifier has the advantages common to all continuous settlers that, being always full, it allows a longer settling time than does an intermittent tank of the same total volume. When not forced to work over capacity, it tends to yield a brighter juice, since the clear juice flows off continuously near the top of the tank, farthest away from the mud. An additional advantage of the Dorr tank may be in the special arrangement for scraping off the scums from the surface of the feed-well. If it can be proved that these scums contain more wax and other "non-settling matter" than the main body of the mud, it may be worth while considering the use of "pre-skimming" tanks for removing the lighter impurities from the juice before settling. The old open clarifiers, where most of the mud formed a blanket of scum at the top, are considered to yield a brighter juice than is obtained from settling tanks.

LIMING.

Most factories still adhere to the method of adding a definite volume of milk-of-lime to each tankful of juice, testing the resultant mixture with litmus or phenolphthalein. But this method has the disadvantage when grinding different kinds of cane that an overlimed tank can only be corrected for by underliming the next one. Some factories titrate each tank of juice when not quite full, and subsequently add a weighed amount of hydrated lime according to the acidity of the juice.

Continuous liming is growing in popularity, since it has the advantage of keeping only a minimum of limed juice in process. This is especially important where *Leuconostoc* is prevalent. Several processes of continuous liming have been developed during the past few years, all depending on adding a small stream of milk to the juice just before it is pumped to the heaters. A very good mixture is effected by the action of the pump, and the lime supply is regulated according to the reaction of the mixture, a small portion of which flows continuously back to the liming station through a sample pipe tapped into the juice-line between pump and heaters. The only difficulty about a continuous liming system is the trouble of running a constant and easily regulated stream of lime into the juice. Valves of any kind are not practicable, since they invariably choke up when throttled down to a sufficiently small stream.

Most systems keep a large excess of milk-of-lime in circulation from the lime storage tanks to a small tank at the liming station, this overflowing in a broad stream which is divided by a movable partition into two portions, the smaller of which goes to the juice while the main portion flows back to the lime storage tank. One of the simplest and cheapest of such arrangements was installed at Binalbagan during the past season. Lime is pumped from a storage tank to a wooden box at the liming station, and overflows in a thin stream down a wooden trough about 1 ft. wide into a pipe leading back to the main supply tank. Extending half-way across the trough at right angles to the flow of lime is a 1 in.

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[1] Report (slightly abridged) of the Committee on the Manufacture of Sugar, presented to Second Annual Convention of the Philippine Sugar Association.

[2] *I.S.J.*, 1924, 266-269, 322-327.

slot in which slides a strip of wood, so that the slot can be closed completely or opened up as much as desired. The small stream of lime falling through this slot drops into a funnel and down a pipe to the intake of the juice-heater pump.

FILTERING.

The mud press station is an admittedly weak point in our present system of sugar manufacture. The type of filter-press now in use is inherently inefficient, and attempts are being made to discard it for improved forms of apparatus used in other industries. There are at least two types of filters which promise a more satisfactory solution of the problem.

Kopke centrifugal clarifiers were used on the settlings from the Dorr clarifiers at the factory of the Hawaiian Commercial and Sugar Co. during part of the past season. It was originally intended to return the thick mud from the Kopke machines to the mill, but apparently it was considered more profitable to discard it.

A few attempts to use continuous suction filters, such as the Oliver or the American, which have largely supplanted the old style filter-press in beet houses on cane mud have proved unsatisfactory owing to the stopping up of the pores of the filter-cloth by wax and other colloidal matter. Some recent experiments by Mr. CARLOS LOCSIN using a small suction leaf filter indicate however the possibility of greatly improving filtration rates by re-settling the mud before filtering and adding aids such as fine bagasse, furnace ash, or lime, together with the use of a coarsely woven filter-cloth.

BOILING.

As long as the greater part of our sugar goes to New York and is sold under the archaic price schedule which makes exactly 96 polarization sugar the most profitable to the seller it will probably not pay us to change our method of boiling, as has been done in many Hawaiian factories since an adequate premium has been paid for higher polarizations.

Mr. PATTERSON of La Carlota has devised a sugar dryer inside the sugar bin which has been of considerable assistance in reducing the moisture of the sugar. Mr. HENNING at Bacalod-Murcia was able to bring down the moisture about 0·2 per cent. by blowing hot air into the bin where the sugar strikes the revolving plate. Granting that the proper place to reduce moisture is at the centrifugals, auxiliary drying devices such as the above may still be of considerable value. The "moisture ratio" at most of our factories is none too low for safety.

(*B*) By F. E. GREENFIELD.

MILL STERILIZATION.

It is acknowledged that there is some loss of sucrose between the time that the first juice is expressed and when it reaches the heaters; but while this loss is considerably more than most of us imagine, the actual amount is difficult to calculate. The inner surfaces of the mill cheeks, those of the returner bar, the juice pans, the canals, and worst of all, the usual type of juice strainer, all form excellent breeding places for micro-organisms.

The two best weapons for combating bacterial action at this point are: (1) Live steam; and (2) formaldehyde. The application of the former by means of steam hose and nozzle does not need to be described; but the latter can be applied in the maceration water, so that every surface with which the dilute expressed juice comes into contact is washed and disinfected.

Adding lime at the mill simply neutralizes the self-inhibiting effect of the acidity caused by bacterial action, which a dilute alkaline solution frequently favours. The proper time to use lime is when washing down the mills, when milk may be poured on the rollers, into the juice pans, etc., in such quantities and concentration as to inhibit the action of micro-organisms, as well as to neutralize such acids as are already present.

Every raw-juice canal should be set at such an angle that the juice runs at such a velocity as to prevent the settling of fine silt on the bottom. Better still, the bottoms of the canals should be V-shaped, so as to obtain a scouring action there.

JUICE STRAINING.

It is to be hoped that the chain-and-slat type of cush-cush conveyor (which cannot be kept in a truly sanitary condition) will soon be replaced by a strainer which will be more compact and more easily cleaned. The Honolulu Iron Works now furnish a pump that will handle the unscreened juice for delivery to the maceration juice distributors, thus eliminating the screening of such juices as are used for maceration.[1] The Peck juice strainer is a recently-designed device which is a distinct advance over any other type, having the following advantages:—It is compact; the amount of juice in transit is small; it may be thoroughly disinfected by steaming; it eliminates the very fine *bagacillo* which undoubtedly is one of the causes of imperfect clarification, and subsequent difficulty in boiling.

It has recently been put into operation here at the factory of the Hawaiian-Philippine Company at Silay. Mr. PITCAIRN, Administrator of the Central, reports as follows:—

> "We found after discontinuing the use, first of the 100-mesh Monel Metal screen and then of the 80-mesh, and substituting coarser centrifugal screen, that we are able to filter all our mixed juice running at the rate of 80-85 metric tons per hour. But when using the 80-mesh Monel Metal screen, we were only able to handle approximately 63 metric tons of cane per hour. We found that the coarser centrifugal screen removed approximately the same amount of cush-cush from the juice as the finer Monel Metal screen and the resultant amount of cush-cush removed is so considerable that it has a direct action on the mud, making the mud very difficult to filter. This difficulty has been overcome to some extent by the addition of excess lime direct to the mud before it is sent to the presses. Also we found that screened bagasse ash added to the mud before it was sent to the presses at the rate of 0·5 lb. per cubic foot of settlings had a very desirable effect on the filtering quality of the mud. We also found that if one gallon of 12° Bé. lime was added at the mud tank for every six cubic feet of mud, it would result approximately, in our case, in a press cake of 3·5 per cent. polarization. We also found that the same amount of lime plus the same amount of ash above mentioned resulted in a fair cake of 3·5 per cent. polarization. This we consider very fair under the circumstances as we were running the mill and boiling-house at the time at approximately the rate of 85 tons of cane per hour or over 25 per cent. above rated milling capacity. The above stated polarization of press-cake was furthermore lower by over 2 per cent. than the polarization we had averaged previously when running without the use of the Peck Strainer.

MUD FILTERING.

Due to the fact that the fine *bagacillo* in the juice is eliminated by the Peck strainer, a difficulty in the filtering of the mud has been encountered at several factories. This is due to the absence of the mat which forms on the surface of the filter-cloth from the deposit of this fine *bagacillo.* This condition results in the early clogging up of the interstices of the filter-cloth making it impossible to obtain a good cake, while the capacity of the filter-presses is materially diminished. To overcome this difficulty various materials have been proposed as an aid to filtration. Amongst these, the cheapest and most satisfactory material so far tried has been screened furnace ash, the use of which at Silay has proved very beneficial, as reported by Mr. PITCAIRN.

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[1] *I.S.J.* 1924, 89.

Heavy liming of the tank settlings has been reported from Hawaii as being beneficial. Needless to say the resultant highly alkaline juice must be returned to the raw juice, and not directly to the evaporator supply tank. During the past year it has become the fashion, following Hawaii's lead, to carry a more alkaline juice than was customary in former years with an apparent improvement in boiling-house work.

CLARIFYING.

Last season the Petree-Dorr process of clarification operated at the factories of the San Carlos Milling Co. and the Talisay-Silay Milling Co. Both report satisfactory results from this continuous settling process, which eliminates the filter-press.

The advantages claimed for this process are many, the most obvious being:—Abolition of the filter-presses with resultant saving in filter-cloth; reduction in number of settling tanks; reduction in personnel; superior clarification resulting in syrup of low viscosity; free drying massecuites; and a clean sugar. It is further claimed that the losses in manufacture are lowered by the installation of the process.

Unfortunately it is difficult to demonstrate this last point, as the determination of the sucrose entering the factory begins, of necessity, with the amount of sucrose in the juice after clarification instead of that in the raw mixed juice as in the usual process. Hence, any loss of sucrose that *might* occur during the process is ignored, the sum of the sucrose in bagasse and the sucrose in the clarified juice constituting the figure for the sucrose in cane.

Possible objections seen by the writer against the process are:—The large body of juice in process; and the protracted period during which the mud is in contact with the juice.

It is my belief that the more rapidly a factory can manipulate the juice into the form of concentrated syrup, the less its losses will prove to be. Undetermined losses increase when a factory is running intermittently, or when the juices are kept a long time in transit, indicating that, though the polariscopic analysis of the juice has failed to show a loss, such has nevertheless been mysteriously occurring.

The usual length of time that juices are in transit from the mill to the evaporator will probably be as follows in most of the factories in these Islands. Mill to weighing or measuring tanks (estimated) 2 mins.; filling, weighing or measuring tanks, 15 mins.; discharging to heater pump tank (estimated) 1 min.; time in pump tank (estimated) 15 mins.; pumping to settling tank (estimated) 1 min.; filling, settling, and emptying settling tank, 60 mins.; a total of 94 mins.

When operating the ordinary settling tank system, therefore, clarified juice will be running to the evaporator 1½ hours after starting the mill, while the scums will be at once thrown out of the system via the filter-presses.

On the other hand, the primary and secondary clarifiers of the Petree-Dorr process will not deliver clarified juice in less than four hours, and the settlings of the primary clarifier instead of being at once thrown out are mixed with dilute juices and returned to the secondary clarifier, the settlings from the latter being also mixed with dilute juices for return to maceration. Juices in contact with mud always deteriorate more rapidly than those decanted from the settlings, still more so if the juices are diluted. If there is any loss occurring during the cycle of the Petree-Dorr process, it will be traceable to this fact.

That such a loss does occur, I believe to be very probable, and may possibly account for the fact that at one of the factories during the past season the so-called Java Ratio dropped from 83·25 in the season 1922-23 to 82·13 in the season 1923-24.

And calculating the normal juice for the two seasons from the final reports, one finds[1]:—

	Per cent.
Indicated sucrose in cane 1922-23	14·516
Actually reported (net cane) 1922-23	14·52
Indicated sucrose in cane 1923-24	14·827
Actually reported (reduced to net cane)	14·34

It must be acknowledged that the process produces a high-class sugar at a lower cost than by the ordinary method ; but we are as yet uncertain as to whether the losses in manufacture are less than in the usual system. If they are more, the question remains whether the saving in cost of manufacture more than offsets the value of the sucrose lost. This I believe to be a question of sufficient importance to warrant the appointment of a special committee and the employment by the Association of a special chemist to investigate and submit a report on the process during the coming season.

EVAPORATING, BOILING AND CRYSTALLIZING.

No innovations have been introduced here, but it is worthy of note that the factory producing the largest crop during the past season, i.e., La Carlota, grained all massecuites with powdered sugar. Although the apparatus has not yet appeared in the Philippines, it is worth while calling attention to the Lafeuille crystallizer,[2] which is quite a radical departure from the present type, in that :—(1) The crystallizer revolves ; and (2) Tubes within the apparatus provide a circulation of cooling water causing a rapid drop in temperature.

The manufacturers claim movement established in every particle of the massecuite, and a rapid reduction in purity of molasses, both of which results should cause a greater yield of sugar, with much less crystallizer capacity than our factories are now equipped with.

A syrup sand-filler, which is claimed to be a marked improvement, in respect of ease of cleaning and amount of sand, compared with most apparatus using this medium, is described by WENZEL HON.[3] Its main feature is the use of the Hauser-Rossak sand filter-plate, a number of which are placed one above the other within a pressure tank, the syrup passing up a central feed, through the layer of sand on the plate, and then out into a reservoir manifold. When the sand has become slimed it is sweetened off, the plates are hoisted out of the tank ; the sand dumped into a tank, where it is washed with hot water, the plates filled with fresh sand, and the filtering operation renewed. This system of filtration, which has worked smoothly at the Rohrbach and Ludenburg refineries, Czecho-Slovakia, since 1919, is claimed to be more economical, and not less convenient, than filter-press work.

It is now reported that the "Celotex" (bagasse boarding) factory which is to be built in Queensland[4] will cost about £300,000, and that the owners will purchase bagasse at a price between 15s. and 20s. per ton, which is thought to be sufficient to compensate the mill for the loss of this material as fuel.

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[1] The following figures are based on Final Comparative Run Report dated July 29th.

[2] *I.S.J.*, 1924, 330.

[3] *Zeitsch. Zuckerind. Czecho-Slovakia.* 1924, 48, No. 44, 422-424.

[4] *I.S.J.*, 1924, 49, 542.

Recent Work in Cane Agriculture.

ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNIVERSITY OF LOUISIANA, 1923.

During the year the field work at Audubon Park was brought to a close after a period of over 30 years, and the experiments transferred to the new College Farm at Baton Rouge, where approximately 100 acres are available for sugar cane studies. The weather during the year in Louisiana was unsatisfactory for most crops because of the large amount of rain and cloud (62 per cent.), and an unusually severe outbreak of borers was also observed in the cane fields. Experiments were conducted at Audubon Park with a new "clover," *Melilotus indica*, planted on fall cane; this grew well, and provided 107 lbs. of nitrogen in the soil per acre. Even in a severe test on stiff, poorly drained land, the growth was satisfactory, although of course the advantage obtained was less marked. The benefit in the stubble crop, after the clover had been turned in on the preceding plant crop, was very evident, the increase in yield being proportional to the amount of clover dug in. The time at which the operation is performed appears to be of considerable importance, however, as regards the benefit accruing. The nitrogen experiments were disorganized because of the removal; but nitrates of soda and ammonia proved to be more effective than ammonium sulphate or calcium cyanamide which two gave practically the same results. This result is considered as of some importance and interest, in that the two most soluble forms gave better results in a year of unusually heavy rainfall.

The attempts of the entomologists to render the egg parasite of the moth borer more efficient were unsuccessful. The tachinid introduced from Cuba was still met with on 16 plantations and appeared to be spreading over the sugar cane parishes; but no effect had been observed on prevalence of borer. For a second year parasites obtained from France were reared on the borer and many adults were released, but no trace of them was seen in the fields. Chemicals designed to attract the borer moths gave negative results. Dipping canes into water heated to 50° C. proved effective against both the moth borer and mealy bug, but any temperature below this figure was unsuccessful against the latter pest. No harm was done to the buds of the cane when they were in the resting condition, but when soft as in windrowed cane this was not the case.

Some study was devoted in the Bacterial Resistance Department to the deterioration of stored sugar. It was noted that the moulds responsible for this are specially susceptible to the presence of carbonic acid gas, and the introduction of a non-sporulating yeast (Torula), which gives off large quantities of this gas, was found to give satisfactory results. Additional advantages were noted in a higher polarization because of the destruction of the molasses films round the sugar crystals, and in less hygroscopicity for the same reason. A study was also made of the relative activity of different races of Torula, the influence of media on them and the number to be added in order to ensure safety.

At the Baton Rouge Station the moth borer received a good deal of attention, especially as regards other hosts of this pest. A study of corn, planted at different times, brought out the fact that the later planted plots were more severely attacked, with the exception that corn sown on May 5th had a comparatively low infestation. This is brought out in a table, showing planting at short intervals between March 10th and June 2nd. The percentage of infected stalks of corn planted between these two dates runs as follows:—17, 45, 72, 68, 65, 35 (May 5th), 62, 75, 88, and 97. Wild grasses were also examined during the fall and winter, and the presence of moth borer caterpillars feeding on them noted. They were found on *Panicum barbinode*, *gymnocarpum*, *dihcotomivorum*, *Paspalum larranageae*, *Holcus halepensis*, *Andropogon glomeratum*, and volunteer rice. These grasses should therefore be eradicated where possible near sugar cane fields.

The study of cane diseases was largely confined to mosaic. The most satisfactory method of control is considered to be the introduction of resistant or tolerant varieties; a number of these have been obtained but none of them has proved very suitable to the Louisiana conditions. Hence an attempt was made to obtain resistant strains from among the local commercial varieties, by selecting less infected clumps in badly diseased fields. This was carried on for about four years at Audubon Park, and in each year less injury was noted, together with increased tonnage in the progeny of the selected clumps. These experiments have been now transferred to Baton Rouge. Red rot was specially severe in 1923, and was responsible for low yields in several localities.

GOOD TILTH AND DRAINAGE ESSENTIAL FOR A SUCCESSFUL CANE CROP IN LOUISIANA. *W. C. Stubbs. Reference Book of the Sugar Industry of the World. Louisiana Planter, July, 1924.*

FOUR-YEAR ROTATION EXPERIMENTS AT THE SUGAR EXPERIMENT STATION, BATON ROUGE, LA. *W. R. Dodson. Ibid.*

These two papers dealing with the pressing need of the hour in Louisiana production may be discussed together. In the first the author dilates upon the perfection of the chemical and engineering sides of sugar cane work in Louisiana, further advances being chiefly concerned with the avoidance of fractional manufacturing losses. Such work cannot be done on the plantation side, in that, instead of problems similar all the world over in the factory, the growing of the raw material, or the sugar cane plant, differs in each individual country. In illustration he refers to the "essential factors" of production as worked out by AGEE for Hawaii—acres, man-days, millions of gallons of water, pounds of nitrogen applied, and so forth. By using these as units that writer has been able to work out correlations between daylight and temperature and the growth of the cane, even to the extent of deducing the factors for the shortest and longest days of the year; so that he is able to assert that the growth during June to August is approximately five times as great as in the winter months. But the cane plant is in the ground for more or less two years in Hawaii, whereas it is required to ripen in a very few months in Louisiana; so that all this work is quite inapplicable to the latter country. The only advantage enjoyed by Louisiana, with its more nothern latitude, is the longer day of sun and warmth is summer.

If the climate permits of early spring germination and an early lay-by in June, good crops may be confidently expected, if certain pre-requisites have been established, namely, proper drainage, sufficient humus in the soil, and deep and thorough preparation in early fall. As regards the first, STUBBS remarks that few if any of the Louisiana plantations are perfectly drained, with a system of ditches sufficient to carry off the heaviest showers in a few hours. Neglect of drainage hinders the development of beneficial microbes, aids bacterial and fungus diseases, delays the appropriation of manurial food by the plants, and results in enfeebled canes liable to the attacks of every pest and disease. The alluvial soils of the country represent a collection of the cream of the soils of many states, but long and continued cultivation of the sugar cane have largely dissipated the humus; therefore ample supplies of manures are necessary to ensure the most rapid growth from June to August. He surmises that the cane in Louisiana may perhaps grow faster than anywhere else in the world during this season. Thirdly, deep and thorough cultivation in the early fall, the turning in of some leguminous crop, ridging as high as the width of the rows permits, are needed to provide the perfect tilth required in spring, in a soil teeming with microbes. Subsequent cultivation should always be shallow, with careful preservation of the ridges, and the middles and quarter drains cleared out after every cultivation. With these conditions and pre-requisites the auther is surely justified in asserting that the detailed work in Hawaii is of little consequence in Louisiana.

He concludes by drawing attention to the high cost of seed cane, which equals from one-fourth to one-fifth of the crop. Although long appreciated and studied, the only palliative suggested is to keep the upper third for planting purposes and to use the rest for milling only. The excuse for not adopting this method was, in the past, lack of labour at harvest time; but the labour problem is far more acute now, and the only relief is to be looked for in the direction of an increased use of mechanical implements.

In the second paper DODSON discusses the causes of the prevailing poor stands and low tonnages. The opinion of plant pathologists is that root rot, red rot, and mosaic are very important factors in the deplorable condition of cane fields in certain sections, and unfavourable weather and the prevalence of the borer undoubtedly intensify these diseases. But in the opinion of close observers among the planters, less damage is caused by these evils where the soil is in the best physical condition and most fertile. If this be true, then the physical and chemical constitution of the soil is more important than is usually supposed. After drainage, the most practical step is the growth of a leguminous crop; and hence the most popular rotation, of corn and cow peas, with cane.

But this entails expense, for the corn rarely more than pays for its production, and the cost of the peas is chargeable to the preparation of the land for sugar cane. His suggestion, therefore, of a four-year course in place of a three year, with only the same two years of cane crops, is a somewhat unpleasant idea at first. But the introduction of soy beans appears to alter the aspect of the case, especially since the discovery of the Biloxi type; and the following four-year rotation is suggested accordingly:—Corn and soy bean or soy bean alone, corn and cow peas, sugar cane plant crop, sugar cane stubble crop. This method ensures a great addition of vegetable matter to the soil, and the sale of the soy beans is expected to pay for the cost of the cow peas in the second year. Furthermore, cow peas after soy bean do not appear to suffer from the disease which attacks them when planted for two years in the soil; the Biloxi bean does not shatter its seed like other varieties; and its harvesting period suits the sugar cane very well. The soy bean will grow till the early frost, and the cow peas would be turned in in preparation for the fall cane planting. This is only one of various experiments being conducted at Baton Rouge along these lines, others including as well a reduction of the nitrogenous manure, corresponding to the larger amount of vegetable matter put into the soil. The preliminary tests are stated to suggest excellent results after two or three cycles of cropping seasons.

THE MYSTERY ARMY WORM. *C. P. van der Merwe, Government Entomologist. South African Sugar Journal, Congress Number, June, 1924.*

Last year this was noted as one of the minor pests of the sugar cane, but this year it appeared again and caused a certain amount of damage on the north coast lands. The sudden increases which characterize this pest are often met with in others, but are not all equally easy to explain; and in the present case the sudden appearance at points long distances apart has earned it its popular name. Army worms are caterpillars which, after eating down a local food supply, migrate over the ground to neighbouring fields. The moths of the local form appear to travel by night and also to lay their eggs at that time, so that it is quite possible for a formidable invasion to occur without seeing the usual swarm which precedes and foretells the caterpillars. The author suggests that this peculiar habit may be protective, as affording a means of escape as soon as the numerous enemies, birds, reptiles, etc., collect for their feast. But this does not protect the larvae, for in damp conditions they are liable to a very destructive bacterial disease, which turns them into mere bags filled with dark liquid, followed by an almost as sudden disappearance.

The mystery army worm attacks any member of the grass family, although maize appears fortunately not to be a favourite food plant. The most usual remedy is the digging of trenches across the line of march, steep sided towards the fields to be protected, with occasional pits into which to sweep the captives. If the ground prove too hard for digging trenches, a heavy log may be drawn to and fro, and the dusty hollow thus formed is said to be as effective as the steep-sided trench. Or the caterpillars may be attacked while feeding, if the crop is thought to be worth saving; and this by scattering poison bait or by shaking the plants and passing a bag or light harrow over the ground. The poison is prepared by mixing 1 lb. of arsenite of soda with 5 lbs. of cheap sugar or molasses and dissolving in 15 gallons of water; this liquid may be mixed with bran, or finely chopped vegetable matter may be dipped in it and then drained. The main injury to the plants is that of giving them a shock and set back, after which although they may recover they are retarded in their growth. Separate appearances have been recorded at intervals of seven weeks, one year, four years or even fifty; there is never any certainty on the subject, and it is well for the planters to know what to do in case their fields are at any time attacked. Dry weather favours the invasion of the pest, and damp weather the bacteria from which it suffers.

SUGAR CANE AGRICULTURE AND MANUFACTURE IN JAMAICA. *F. M. Kerr Jarrett. Louisiana Planter Reference Book, July, 1924.*

This short paper contains a good deal of information on the agricultural side of Jamaica sugar estates, not usually obtainable in the many current references to the industry. The slump in the rum trade a very few years ago appears to have done more than anything else to resuscitate the sugar industry. During the past three or four years, indeed, the change from methods which are aptly described as archaic has been somewhat remarkable, and the island, although its ultimate production is not likely to assume the large proportions in other of the Greater Antilles, bids fair to become the dominant partner in sugar production in the British West Indies. Only two factories exist with a capacity of 10,000 tons of sugar, namely, Bernard Lodge in St. Catherine and Gray's Inn in St. Mary, but neither of these is yet working to full capacity. Another is building at Plantain Garden River in St. Thomas. Because of the physical configuration of the island, it is difficult to get large blocks of suitable land for sugar cane growing, and where such areas are obtainable banana growing is a formidable competitor. But there is some hope of an alliance between these two industries, because it is being gradually recognized that banana land needs a rest, and that this can be conveniently obtained by rotating it with sugar cane. The author sees great possibilities in this for the future of the sugar industry.

He also points out that "it is hardly believable that there can be another country so small where the agricultural methods are so varied and divergent, due entirely to climatic conditions." Some of the methods are certainly not abreast of modern ideas, but we have to confess that without them it is difficult to see how the industry could exist. One may question whether growing the cane under these conditions is an economic proposition, but after all the acid test lies in the financial results, and these appear to be favourable. Two cases with such divergence are given in estates near Montego Bay in the parish of St. James. "Just outside the town" are four separate estates in rich alluvial soil, where there is a well distributed rainfall of 60 inches, and irrigation by gravity is available. Here the usual methods adopted in other sugar cane countries are carried out. But about four miles off are two other estates where the rainfull is only 40 inches, and there is no irrigation. The canes lead a precarious existence, replanting is never done if it can be avoided, the "roots" of the cane must be protected at all hazards, all of which necessitate entirely different methods of cultivation.

Sugar cane planting, it must be remembered, is something like 200 years old in Jamaica, and it is not surprising that the main need in the cane lands is humus. Some of the methods of producing it are interesting. *Fly penning* consists in making the manure on the land within moveable cattle pens. A certain portion of the poor lands on the estate are put under guinea grass, the universal fodder grass of the island, and this is cut and carted to the pen. Each pen is about an acre in extent and is railed in by bamboo or wire fencing; it takes about a week to get the ground covered with cattle droppings and urine, and then the pen is moved to the next acre; and thus the whole area is covered (very much as in India the land is manured by the flocks of goats). When planting follows, the land is dug over and furrows are made, the manure not being much injured meantime by the dry weather. *Penning on the stock*, on the other hand, consists of a similar method being applied to land which is being cropped; as soon as the canes have been cut one-acre pens are erected, with the difference presumably that cane trash and tops enter into the supply of vegetable matter. The stumps are not injured as the ground is dry, and the pens are moved on as they are in fly penning. When the shoots appear in the rainy season, the vacancies are immediately supplied (by dibbling) so as to bring up the field to its normal cropping capacity. But besides these methods large quantities of pen manure are raised in the ordinary way, and this when well rotted is carted on to the fields, commencing with August and during the succeeding months. Such methods may appear to be wasteful enough as regards the manure but, on the other hand, they are very economical in labour, the cost of weeding being stated to be often as low as 36 c. per acre.

In Clarendon district in the middle south of Jamaica, irrigation is general, and therefore the usual methods of cultivation are accepted. This region also possesses the only set of steam tackle in the island. In Westmoreland district on the extreme west, the rainfall is if anything excessive (80 ins. per annum), and the largest quantity of sugar cane in any district is grown here. Great difficulty is experienced in cultivating the land because of the saturated nature of the soil, and replanting is done regularly every three or four years. The other factories are scattered about in various corners of the island, wherever there is a fair annual rainfall. The mountainous character of the country makes it impossible to connect most of these small estates as is being done everywhere at the present day. In places, great efforts are being made to increase and conserve the supplies of bagasse, and only where wood is scarce is it not possible to use this as an additional source of vegetable matter for the all important pen manure. Lastly, various implements and tractors are being tried and are coming into use, for on many plantations the area cultivated is strictly limited by the inadequacy of the labour supply, and better canes and cheaper labour are of great urgency.

C. A. B.

The Construction and Arrangement of Warehouses for the Storage of Sugar.[1]

By H. I. SHOEMAKER.

CONSTRUCTION.

(1) *Materials.*—Reinforced concrete floor, on a sand fill, reinforced concrete walls, and well-laid corrugated steel roofing, should be specified. There is some difference of opinion about the best type of roof, and the writer was formerly of the opinion that a "specification" roofing, laid on well-seasoned 1¼ in. matched lumber, was the best. Such a roof can be made nearly flat, that is, on a pitch of 1 in. to the foot. Due to the fact that in tropical climates most patent roofings are not very durable, and require considerable attention and cost for maintenance, it seems that an iron one is most expedient, both in respect of first cost and of maintonance charges.

(2) *Construction Details.*—Floors to be of dense concrete, not less than six inches thick, laid on a well-settled sand or gravel fill. This last insures against ground water seeping-up through it. The top of the floor should be well floated with neat cement, to make a hard, impervious surface, which will not be affected by sugar solutions. A movable false floor, consisting of sections composed of 1 in. × 3 in. battens, separated 1 in., and secured to 2 in. × 4 in. cross pieces, should be placed over the concrete floor, and on these *amacanes* (or split bamboo mats) are to be spread.

Walls to be of concrete to be not less than five inches thick, made of a dense mixture, with the addition of a good waterproofing compound to the tempering water if the warehouse is in a situation subject to driving rains. Suitable reinforcing against temperature cracks is sufficient for the walls, as the weight of the roof, etc., will be carried by columns or pilasters spaced at suitable intervals. The height of the walls is a matter of individual preference, though a height of 20 ft. to the bottom chord of the roof is very suitable to most conditions.

Roofs to be of galvanized corrugated steel sheets, not lighter than 22-gauge, laid on a pitch of not less than six inches in one foot ("quarter pitch"). Sheets to be lapped not less than two corrugations at the sides, and not less than 12 in. at the ends; the lapped portion of sheets to be covered with an approved rust-resisting paint or composition before laying. Roofing to be secured to purlins by galvanized screws or nails and lead washers, if wooden trusses are used, or with galvanized bolts and lead washers if steel construction is used. All ridges and hips to be covered with extra wide ridge roll, and all valleys and junctions of lean-to roofs with walls to be flashed with 22-gauge galvanized sheets or, preferably, sheet zinc. The roof should be painted with some approved rust-resisting paint.

In regard to openings, no ventilation is desired, so to that end design and construction should be such as to make the building as air-tight as possible. All cornices and gable ends should be boxed in tightly. Any windows that may be necessary for lighting purposes should be placed as high as possible (just below the plate), be glazed with wire glass and put in so that it is impossible to open them. This principle of the prevention of circulation of air is one of the most important considerations in sugar warehouse construction.

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[1] Report (slightly abridged here) of the Committee on Warehouse and Sugar Storage, presented to the Second Annual Convention of the Philippine Sugar Association.

Construction and Arrangement of Warehouses for the Storage of Sugar.

ARRANGEMENT.

The matter of general dimensions and arrangement of sugar warehouses is, of course, dictated by many varying conditions; but the personal experience of the writer, and his observation of a number of good warehouses, has suggested the following:—

Width, from 65 to 70 ft., exclusive of train sheds, is convenient, both for piling and loading out. Height, about 20 ft. from floor to bottom chord of roof is convenient, allowing sufficient dead air space above the piles, and giving sufficient roof for overhead conveyors. Length.—This depends on the capacity desired, of course. Height of floor.—For convenience in loading out into cars, the floor should be elevated above track level sufficiently to bring the floors of the sugar cars used at the same level as the warehouse floor. This has also the advantage that the sand fill under the floor is deep enough so that there is little danger of surface moisture ever getting up to the floor level.

As to general arrangements, the writer is in favour of of a warehouse having tracks running down each side, in lean-to sheds which are of the same construction as the main building and form a part thereof. The sides of the warehouse proper are open up to the tops of the train sheds. The only doors in the building are four folding ones, at the ends of the sheds. Experience has shown that this arrangement minimizes the sweating of bags due to currents of moist air sweeping through the building when the doors are open. With a single track running down the centre, the piles of sugar on either side form a tunnel through which moist winds blow and "sweat" all the bags along the edges of the piles.

MECHANICAL CONVEYORS AND PILERS.

The installation of mechanical conveyors and pilers is a great advantage in any sugar warehouse, as the costs of handling can be reduced thereby some two centavos per picul. The equipment suggested would be: (1) An overhead conveyor, secured to the bottom chords of the roof trusses, and running down the middle of the warehouse, to deliver bags from the sugar room to the piles; and (2) Two portable elevators, or bag pilers, to deliver sugar from piles into the sugar cars.

PILING OF SUGAR.

The principal consideration, aside from preparation of the floor to receive the sacks, is the determination of the maximum height to which sugar can be piled without the danger of molasses oozing out of the bottom row of bags. Economic conditions have to govern here, since unless sugar is practically bone dry, protracted storage in piles more than ten bags high results in molasses extraction from the bottom bags.

It is, of course, impracticable and in most cases beyond financial resources to provide warehouses extensive enough to limit piles to ten high, so a somewhat higher limit must be adopted, even though some rebagging of sugar at the bottom of the piles is necessary. If the moisture is kept below 1 per cent. (the factor of safety being less than 0·25) it seems permissible to pile 20 bags high, but not more. With higher piles, too many bags are liable to be broken both by the pressure of bags on top, and by the tumbling of the top bags to the floor when loading out.

As to large piles *versus* small ones, it is recommended that piles be continuous, so as to present as few surfaces as possible to moisture-laden air.

The China National Sugar Refining Co.'s sugar-house at Shanghai will operate shortly, and will have a production of about 200 tons daily.

The 1924 and 1925 Sugar Crops in Java.

(Department of Overseas Trade Report.)[1]

1924 crop.—The estimated production for 1924 crop is 30,451,444 piculs; if this figure is reached it will be the first time in history that the sugar crop has reached 30 million piculs.

Analysing, the estimates are:—

	PICULS.
Superior	16,713,514
H.S. and 16/H	2,189,816
Optional	10,395,546
Muscovados	491,500
Superior soft sugar	256,750
Molasses	382,635
Bag sugar	21,653
Total	30,451,414

Total sales of first-hand business up to July 13th amounted to 26,249,553 piculs; figures to June 29th show that Japanese firms have purchased 10,033,760 piculs, European firms 7,980,663 piculs, Chinese firms 7,124,355 piculs, and British Indian firms 460,167 piculs. The last sale recorded up to the time of writing this report was 20,000 piculs Superior on July 4th, since when no further bids have come in. It is rumoured that a Japanese exporter has since bid f. 13·25 per picul, but the Vereenigde Javasuiker Producenten's limits are a little higher

Second-hand business 1924 crop for Superior closed on July 20th, at the following prices per picul:—

	BUYERS.	SELLERS.
Ready, July 20th	f. $14\frac{1}{2}$	f. $14\frac{5}{8}$
July/August and August/September delivery	$13\frac{3}{8}$	$13\frac{1}{2}$
September/October delivery	$13\frac{1}{2}$	$13\frac{5}{8}$
October/November delivery	$13\frac{5}{8}$	$13\frac{3}{4}$
November/December delivery	$13\frac{3}{4}$	$13\frac{7}{8}$

The trend of prices is dependent on the world's market prices, and no opinion of the general outlook in sugar can be expressed from Batavia; it, however, appears assured that the production for Java will show an increase during the next five years.

The total export of the 1924 crop from January 1st to June 30th, 1924, is 562,009 tons sugar and 41,735 tons residue, the figures for 1923 crop during the same period last year being 684,272 tons and 41,735 tons, respectively. Principal countries of destination during the current year are British India 147,890 tons, Hongkong 90,184 tons, United Kingdom 62,144 tons, and France 66,896 tons.

1925 crop.—First-hand business in the 1925 crop is already taking place, and forward sales made by the Vereenigde Javasuiker Producenten up to July 13th totalled 6,609,550 piculs. The approximate limits are f. 12·50 for Superior, and f. 11·25 for Head Sugar and Muscovados.

No reliable estimate of the 1925 crop can be made at present; it may, however, be expected that the crop will be heavier than in 1924, as a greater acreage will be planted up.

There is plenty of tonnage available for transporting the output of the 180 sugar mills now grinding, and 3,035,802 piculs—viz., 184,324 tons head sugar and 4526 tons residue—left Java ports in June. In all respects the sugar industry is in a flourishing condition, production costs show a slight decrease on 1923, and labour is plentiful.

Mr. R. Renton Hind recently issued the following warning to the planters and mill interests of the Philippine Islands[2]:—"Prospects for the coming world's sugar crop are wonderfully bright; in fact, so brilliant that in spite of increased demand there is a very material danger that there may be overproduction this year with the result that the present satisfactory prices may suffer a slump. For this reason it is highly important that the sugar interests of the Philippine Islands guard against over-enthusiasm about the coming crop and conduct its business along conservative lines."

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[1] Report of Mr. H. A. N. Bluett, Commercial Agent, Batavia, to July, 1924.

[2] *Sugar News*, 1924, 5, No. 10, 589.

American Commerce Reports.[1]

ARGENTINA.

The yield of sugar for the 1923 season resulted in 256,900 metric tons, which is the largest production since that of 1919. Of this total, the great majority, or 201,000 metric tons, came from the Province of Tucuman. The market for sugar was strong at the end of the year and stocks of sugar were abundant, particularly of the refined pilé class. It was expected that by the beginning of the season in May, 1924, there would be a surplus of over 25,000 metric tons. The following table gives statistics of the sugar industry in Argentina from the year 1913:—

Argentine Sugar Statistics.

Year.	Stock on hand January 1st.	Production.	Importation.	Exportation.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
1913	24,000	277,819	75,381	59
1914	165,141	335,956	6,509	64,690
1915	228,916	149,299	23	53,823
1916	98,415	84,069	30,326	404
1917	6,406	88,076	160,157	32
1918	51,607	127,535	33,269	9
1919	2,402	297,308	82,138	1,453
1920	160,395	203,224	—	81,813
1921	61,806	195,567	58,400*	—
1922	90,773	209,119	68,226	—
1923	118,118	253,904†	14,000	—
1924	121,022	—	—	—

* Including 20,200 metric tons of national sugar brought back into the country.
† After deducting shrinkage during refining process.

Of the 25 distilleries in Argentina producing alcohol from molasses, 20 are found in the Province of Tucuman, two in the Province of Jujuy, and one each in the Provinces of Corrientes and Salta, and the territory of the Chaco. No official figures are as yet available covering the production of alcohol from sugar in 1923.

The 35 sugar mills and seven sugar refineries in Argentina are located as follows:—27 mills and five refineries in Tucuman Province, two mills in Province of Salta, three mills in the Province of Jujuy, one mill and one refinery in the Province of Santa Fe, one mill in the Province of Corrientes, one mill in the territory of Chaco, and one refinery in the Federal capital.

BELGIUM.

Sugar beets are grown in Belgium to an important extent, and beet sugar is exported in considerable quantities, amounting to 3993 metric tons in 1923, 10,406 tons in 1922, and 15,545 tons in 1913. The great decrease in the exports during 1923 is attributed to the action of the Belgian Government in prohibiting the export of more than 50 per cent. of the production of any Belgian sugar refinery.

No beet sugar is imported, although quantities of cane sugar, principally from Cuba and Peru, are brought in, and Antwerp serves as a port of distribution and transshipment.

MEXICO.

The decline in production of sugar in Mexico in 1923 from that of 1922 amounted to about 20 per cent., according to official estimates. While the 1922 figures used are from independent sources they are substantiated by a decrease in exports to the United States of approximately 30 per cent.

Sugar is an important export crop. The following figures show the production for various years:—

	Metric tons.
Five-year average, 1909 to 1914	148,000
1921	130,000
1922	149,000
1923	121,471

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

PARAGUAY.

The most important item in the manufacturing industry of Paraguay is sugar. The country is well adapted to the cultivation of sugar cane, and the production of the eight factories supplies the largest portion of the domestic demand. Sugar beets have not been tried in this country. The average yearly consumption of sugar is given at 3000 metric tons. The domestic production supplied more than 50 per cent. of the demand of the community in 1923. Imports during the past two years were lower than during pre-war years

The aggregate capacity of these factories is reported to be 6000 tons per annum, one-half of which is accredited to the Azucarera Paraguaya. However, during 1923 only six were in actual operation and these on a reduced scale of approximately 30 per cent.

PORTO RICAN SUGAR CROP.

The economic improvement which was anticipated in Porto Rico early in the year has not materialized and the general situation at present is unfavourable. Liquidation of accounts due is slower, and importing merchants are not inclined to extend further credit. Importers are curtailing orders as the major crops are now in, and the second six months of the year are usually more or less dull commercially. Bank deposits have increased somewhat, but the situation has changed since the first of the year when deposits showed unexpected increases.

The sugar crop has been completed with a production close to 10 per cent over estimates and 17·5 per cent. over that of last year. It had been expected that the final outrun would exceed pre-crop estimates, but it was not thought that the total increase would amount to 38,744 short tons as shown by complete figures. The crop amounted to 445,469 short tons (397,740 long tons) and is the largest produced in Porto Rico since 1920-21, the increase being well distributed among the various mills. This increased outrun has not reacted to the benefit of the industry as much as might be expected as in some cases the percentage of yield was lowered, reducing profits to both plantations and mills. Also, stocks were withheld for a rise in price and were later disposed of on a falling market.—[Commerce Report, July, 1924.]

Publications Received.

Volumetric Analysis. Francis Sutton, F.I.C., F.C.S. Eleventh Edition, revised throughout, with numerous additions, by W. L. Sutton, F.I.C., and A. E. Johnson, B.Sc., F.I.C., A.R.C.Sc.I. 1924. (J. & A. Churchill, London, W.1.). Pp. 624. Price: 35s. net.

Brief notice may be given of the publication of another edition of this standard work, which is to be found in almost every laboratory undertaking analyses of a general nature. Its secret of success hitherto has depended on several factors, among which may be mentioned the judicious selection of methods, the precise detail in the description of these methods, and the convenience with which reference may be made. Several of the sections have now been revised, new methods having been included, and others excluded. Information is given of the methods of standardization of the burette, the pipette, and the graduated flask now adopted by the National Physical Laboratory,[1] and of the permissible limit of error in each. Regarding the section on sugar analysis, the volumetric processes selected are on the whole well adapted to the use of the commercial laboratory. This new edition of "Sutton" will, we think, maintain the high reputation established by its predecessors.

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[1] *I.S.J.*, 1924, 606.

Publications Received.

Betriebskontrolle der Zuckerfabrikation. III Band: Wärme und Dampftechnische Rechnungen. Dr. Ing. Oskar Wohryzek (Albert Rathke, Magdeburg Germany). 1924.

Notice of the publication of the two previous books of this series of books in German treating with the technical control of beet sugar manufacture has been given in these columns,[1] these dealing with: (1) Methods of sampling and analysis, and the organization of laboratory work; and (2) the calculation of the analytical results obtained, and other computations. This third member of the series deals with heat and steam. It presents a large number of calculations (many of them of an elementary nature, obviously intended for the use of the student of the beet industry) on heat, steam production and steam consumption. As in the case of the two previous works noticed, it has been compiled with great care and thoroughness. It is likely to prove of much service, not only to the young chemist and engineer, but also certainly to the more experienced technologist by reason of the many useful data therein collected.

Commission Chargée de l'Étude des Questions Relative á l'Accroissement du Rendement en Sucre des Betteraves: Année 1924. Émile Saillard. (Ministère de l'Agriculture, Republique Française, Paris, France.) 1924.

Mr. Saillard here summarizes the information he has collected during his visits to the principal seed drying-houses in France and certain other countries (Germany, Czecho-Slovakia, Poland, and Denmark). It is a valuable brochure for those interested in the question of beet seed production.

Technologie Cukru. Ing. Ales Linsbauer ("Proudy," Prague, Czecho-Slovakia). 1924.

This is a comprehensive and profusely illustrated textbook on the manufacture of beet sugar by the well-known technologist, Dr. Linsbauer, of Brno. It is printed in the Czech language, and the information which the author gives of modern practice in his progressive country is therefore unfortunately available only to comparatively few.

Jahr-und Adressbuch der Zuckerfabriken: Betriebzeit, 1923-24. C. Artur Schallehn. (Albert Rathke, Magdeburg, Germany.) 1924.

This is the latest edition of Rathke's well-known handbook. It presents a good number of tables relating to sugar production and consumption in different countries; and gives information regarding societies and associations relating to the beet industry, but mainly consists of list of beet factories and refineries in Germany and other countries. This information is very complete, and particularly well arranged, against each factory being stated the following data: firm, location, capital, president, staff, nature of the plant, date of its installation, and daily and annual production.

Sampling and Analysis of Coal, Coke, and By-Products. [Methods of the Chemists of the U.S. Steel Corporation.] Second Edition. (Carnegie Steel Co., Bureau of Instruction, Pittsburgh Pa., U.S.A.) 1923.

Contents:—Sampling and Analysis of Coal and Coke (sampling, physical tests, methods of analysis); and of By-products (these include ammonium sulphate).

Scales and Weighing: Their Industrial Applications. Herbert T. Wade. (The Ronald Press Co., New York.) 1924.

Contents include:—Principles of weighing; platform scales; automatic and indicating scales; counting scales; bulk weighing by automatic scales.

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[1] *I.S.J.*, 1921, 694; 1923, 262.

Review of Current Technical Literature.[1]

Four Mills compared with Three Mills and a Crusher in Java. *Symposium.*

Archief, 1924, 32, 4e deel Versl., 2e Afl., 71-91.

At the recent Congress of sugar men which took place in Java recently, a paper by W. J. Wijn on the subject of four mills *vs.* a crusher and three mills was read, and following this a discussion arose. Mr. Wijn's conclusions were: (1) that the advantage in placing a mill before a 3-mill (9-roller) installation is much greater than that obtained from a crusher before the same installation; (2) that this advantage diminishes as the campaign progresses; (3) that the addition of a mill before an installation of a crusher and three mills has a greater effect than has the addition of a mill to a 3-mill installation (the crusher rendering the cane more easily expressed, which is generally accepted); and (4) that the effect of a crusher before an installation of four mills is on the whole percentually greater than that of a crusher before three mills. In the discussion following this paper, Mr. E. Mooyaart pointed out that his colleague's conclusions were drawn from the Java Mutual Congress sheets, which, however, do not give the dimensions of the crushers or rollers; and so, to obtain a better idea of the actual results achieved, he had grouped the various milling installations according to their capacity and the juice-water lost factor.[2] As the result of data thus collated, and of other considerations, his conclusions were: (1) that an installation of a crusher and three mills has a higher capacity than four mills, for the reason that the crusher prepares the cane better than a mill, this being specially true in the working of hard canes. Dr. T. van der Linden (President of the Congress) concurred with the opinion of the previous speaker, so long as the comparison is made on the basis of the juice-water lost, and provided the factory is of high capacity. Mr. F. W. Helmers supported this by giving 15,000 piculs (915 tons) as the limiting capacity above which the use of a crusher is preferable to a mill, but he added that it would be much better if the capacities were based on piculs of fibre, instead of piculs of cane. Mr. F. W. Bolk questioned the value of the juice-water lost as the only criterion for judging the value of milling installations,[3] especially as this factor does not take into account the influence of the fibre content, which varies from factory to factory. He further hesitated to state a limiting capacity (as Mr. Helmers had done), since this depends so much on the nature of the cane being crushed, whether, e.g., it is 70 per cent. of soft and 30 per cent. of hard, or conversely. Mr. M. Hoolboom believed that the limit when grinding soft canes should be 13,000-15,000 piculs (793-915 tons) for mills 30 in. × 60 in., above which a crusher and three mills is advantageous. Other speakers expressed other ideas as to this limiting capacity. Summarizing the discussion, the President said that the general opinion of the meeting appeared to be that, especially for hard canes, a crusher and three mills should be used for capacities above 13,000-17,000 piculs (793-1037) tons, and that for lower amounts, especially when grinding soft canes, a mill instead of a crusher should be placed in front of the 9-roller installation.

Data regarding the Payment of Cane in Mauritius and in South Africa (Natal). *Anon.*

South African Sugar Journal, 1924, 8, No. 3, 182.

"In Mauritius the planter is paid two-thirds of the extraction in white crystal sugar, bagged and delivered at the docks in Port Louis, the mill having to pay all the expenses and make its profits on the remaining one-third, which, judging by results, is quite satisfactory. Up to about ten years ago the millers were estimated to make 20,000 rupees (£1333) net profit on every 1000 tons of sugar manufactured from planter's cane on this basis. The planter also had a certain amount of the by-products, such as molasses, press-cake, and ashes given to him, which he used for fertilizer. As the mills have been improved, and modern methods adopted, the profits have necessarily increased; and to-day, in many cases, 70 to 74 kg. of sugar are paid for a ton of cane delivered to the mill. It does not follow that the South African millers are in a position to pay as much for cane, because their extraction is less and their cane has a higher fibre content; but two-thirds of the extraction should satisfy the planters and meet the millers. Thus the planter entitled to receive two-thirds of the extraction would get 66⅔ kilos of white crystal sugar delivered on rail to Durban. A price of £15 per ton, or 3½d. per kilo, would represent 19s. for the cane in the factory yard; and, allowing 14 per cent. sucrose and a total loss of 3·30, the ton of cane would be worth 20s. 9d. On a ratio of 10 tons of cane to 1 ton of sugar, and allowing £15 for a ton of sugar, and cane at 19s. per ton, the miller would make £4 10s. per ton of sugar, from which will have to be deducted milling, bagging, railage, storage, etc., which should not exceed £2 per ton."

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] See *I.S.J.*, 1823, 140.

[3] *Cf.*, *I.S.J.*, 1923, 140.

Data on Chemical Control for Java Factories in 1923. *Anon. Archief, 1924, 32, Mededeel. No. 42, 351-387.*

Only a few figures can here be given from the voluminous data which are collected by the Java Experiment Station annually, the calculation of which must involve an immense amount of time. Some average data showing the relative value of the type of milling installation in Java here follow; from which it will be noted that a new factor, viz. the juice lost per 100 of fibre has replaced that previously selected, namely the juice-water lost per 100 of fibre.[1]

Installation.	Number of factories.	Sugar Extraction.	Maceration Per cent. Fibre.	Juice lost factor.
No crusher, 3 mills	31	90·5	114	64
1 ,, and 3 mills	42	91·5	116	57
No crusher, and 4 ,,	28	92·5	120	52
1 ,, and 4 ,,	53	93·5	131	46

Commenting on these results, it is pointed out that the 12-roller installations lost 12 parts of juice less than the 9-rollers, and that the fourth mill is responsible for an increase in the sugar extraction of two. In the 11-roller plants (one crusher and three mills) the juice lost was 57, so that here the crusher is to be credited with an increased sugar yield of one. It therefore would seem that the value of the crusher is about half that of the fourth mill. Among other data selected the numerous headings in these very elaborate control sheets are: Maceration per cent. fibre; this in 13 cases was above 150 and in 23 was below 100 (the highest recorded being 167 and the lowest 65). Water in the final bagasse per cent. fibre; this was more than 110 in three and less than 85 in nine factories. Fibre content: this was above 15 in 12 factories, and below 12 in 26 (the highest being 18·2 and the lowest 10·4 per cent.). Brix-free cane-water per cent. fibre: this was calculated to be between 38 and 69 in the case of nine factories. Undiluted raw juice per cent cane: this was more than 80 in 13 cases, and below 67·5 in four. Particulars of the milling installations now running in Java were given. There are two employing rotating knives above the cane carrier as a levelling device; five have shredders; and 2 have double crushers; 13 have one engine for the crusher, first and second mills; seven drive the crusher and first mill together; nine the first and second mills together; six the second and third together; and 12 the third and fourth together. Data are also stated for the hydraulic pressure, the setting of the mills, and the rate of grinding. Tegowang was the name of the factory which had the highest rate of grinding, namely 20,076 piculs per 24-hour day (1225 long tons) for a crusher, 26 in. × 60 in., and four mills, 30 in. × 60 in.

Cutler Process of making Sugar (or Syrup) from Refuse Beet Molasses.[2] *Heber C. Cutler. Facts about Sugar, 1924, 19, No. 13, 303-304.*

Hydrochloric acid is added to beet factory waste molasses in quantity "sufficient to substantially neutralize the alkaline constituents present," this being done while the product is hot, after which it is filtered, dialysed, and boiled to massecuite. Alternatively, if the product in view is table syrup, the hydrochloric acid is added in suitable excess, and conditions so adjusted, that a certain amount of the sucrose is hydrolysed, after which filtration and dialysis and concentration follow. The use of HCl previous to dialysis results in that operation being carried out in a much shorter time, and a syrup of higher purity being produced, than when the molasses is treated in an alkaline condition. It is stated that the beet sugar produced by this process is free from the usual objectionable odour and flavour, and that, moreover, it is equal to the refined product, "except for a slight colour." During the 1924 run, 4600 tons of molasses were treated by the Cutler process at the factory of the Springville-Mapleton Sugar Co., Springville, Utah, which amount will be doubled this year.

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[1] *I.S.J.*, 1923, 140.

[2] *I.S.J.*, 1922, 292, also U.K. Patent, 169,113, and U.S. Patents, 1,493,967, 1,494,218; *I.S.J.*, 1921, 706.

DETERMINATION OF THE PHOSPHORIC ACID AND POTASH IN CANE JUICES, AS AN INDICATION OF THE FERTILIZER REQUIREMENT OF THE SOIL. Carlos L. Locsin, *Sugar News, 1924, 5, No. 8, 394-408.* Herbert Walker. *Ibid., 1924, 5. No. 8, 402-403.*

In previous articles[1] Mr. WALKER has demonstrated the value of the analysis of the juice as an indication of fertilizer requirement of the cane. Working on these lines, Mr. LOCSIN has carried out field trials, in which the effect of molasses ash, ammonium sulphate, calcium superphosphate, and slaked lime was compared with plots that received no treatment. One of these trials was exceptional in that it showed a greater gain from phosphoric acid and potash than from nitrogen alone; and in another, juices from phosphoric acid plots ran higher in phosphoric acid than in the case of juice untreated with this constituent. Mr. WALKER comments on this by saying that he had never been able to demonstrate that phosphoric acid applied in the usual dose as fertilizer has any effect on the phosphoric acid content of the juice from the ripe cane grown on such plots, although potash fertilization does increase the potash content, especially in soils deficient in that element. The theory has been advanced that the chief benefit of phosphoric acid is its stimulative effect on the young cane. If this be true, one might expect to find greater differences in the juices of fertilized and unfertilized plots while the cane is very young, shortly after fertilization, which would nearly equalize on maturity.

PREVENTION OF THE MOULD ETCHING OF POLARISCOPE QUARTZ PARTS. Herbert Walker. *Sugar News, 1924, 5, No. 8, 407.*

One of the minor problems encountered in a tropical sugar factory is the difficulty of keeping polariscopes in good condition. During damp weather the Nicol prisms and quartz wedges become infected with a mould growth which, unless removed, etches into their polished surfaces and eventually ruins them for accurate work. Heretofore the only remedy has been to take the instrument apart occasionally and clean the optical parts. This is a rather troublesome operation, since it generally means readjustment of the scale, and, unless done with great care, may cause serious damage to the delicate prisms. During the past season the writer has been experimenting with thymol as a mould preventative, with very promising results. The polariscope is disassembled, cleaned, and a few crystals of thymol inserted in the compartments at each end of the polarizing and analyzing nicols and in the bottom of the brass case which covers the wedge mechanism. The polariscopes at two Centrals in the P.I. thus treated have stood for more than six months without any sign of mould growth, although it had formerly been necessary at one of these factories to clean the prisms every two weeks. Polariscopes not treated with thymol all showed some damage from mould when opened up at the end of the grinding season. Since thymol is slowly volatile, one treatment will not last indefinitely, but as long as the odour persists the instrument is probably safe. Present indications are that the antiseptic will not have to be renewed more than once or twice a year.

EXTRACTION OF SUGAR FROM BEET MOLASSES BY THE FRIEDRICH AND RATJORA PROCESS, USING ACETIC ACID. J. de Grobert. *Journal des Fabricants de Sucre de France, September 20th, 1924.*

As far back as 1882 attempts were made to extract sugar from molasses by the addition of acetic acid in a somewhat similar manner (apparently) to that recently proposed by

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[1] *I.S.J.*, 1923, 214, 478.

Friedrich and Ratjora.[1] But the industrial trials which were undertaken for the purpose of examining this process of Pfitzinger[2] were a failure, it being found that the sugar was in such a fine state that its separation was impossible either by centrifuging or by filtration; and that the loss of acetic acid reached a high figure in attempting to recover it. Friedrich and Ratjora's process is adversely criticized on several points.

Ash in the Rind and Interior of Beets. *Anon.* (Report of the Institut fur Zucker-Industrie, Berlin). *Contralblatt für die Zuckerindustrie, 1924, 32, No. 40, 808.*

Starting with 4190 grms. of roots, 690 grms. of rind, containing 26·83 per cent. of dry substance, and 1·09 per cent. of ash, and 3425 grms. of interior containing 25·84 per cent. of dry substance and 0·41 per cent. of ash, were obtained. Figures for the analysis of the carbonated ash found were as follows:—

	Rind of Roots.	Interior of Roots.
Insoluble in HCl	5·19	1·88
Soluble Silica	1·47	0·45
Fe_2O_3	1·53	2·71
P_2O_5	11·06	9·34
CaO	11·10	17·40
K_2O	32·83	28·63
Na_2O	5·07	5·91
SO_3	3·23	2·90

An Automatic Signal for Over-Loaded Induction Motors in Milling Installations using Knives. *Irwin McNiece.* *Sugar News, 1924, 5, No. 7, 340-341.*

A device is described for giving warning of an unusual block of cane in milling installations using knives, this being equipped with red lights for indicating the approach of the overload of current, and a gong to announce that it has arrived. Some engineers hold that such devices should not be required, since motors of sufficient capacity to drive the knives through any jam occurring should be installed; but calculations here presented prove that if continuous operation in the worst emergencies were practised, an excessively large motor would be required. Installations of ordinary power with such a signal device as that here described are much to be preferred.

Some Remarks on Pressure Evaporation. *Martin J. Kermer.* *Facts about Sugar, 1924, 19, No. 2, 36-38.*

According to this writer, all the new beet factories that will be built (in Europe) will no doubt be equipped with machinery suitable for using the pressure evaporation system, not only to gain in fuel economy, but also because the original cost of installation will be less. It is not possible to charge the evaporating equipment as installed in present-day factories by merely eliminating the condenser and vacuum pump, and increasing the steam pressure in the effects, because the juice-space in such evaporators is very large, and therefore considerable time is required to pass the juice through before properly concentrated, discoloration and loss of sugar thus resulting. Only the rapid circulating or film type in which the juice passes at high velocity over the heating surface can be used for this purpose. But, besides the evaporator, the prime-mover must also be considered. In a well-balanced factory the exhaust from the engines should be equal to the amount of steam required by the evaporator. Normally this is supplied at about 7 lbs. back pressure. If this back pressure is increased, say to about 40 lbs. in order to supply the pressure evaporator, the water rate of this prime-mover has considerably increased, providing all other conditions remain the same. It is very evident that under those conditions it is doubtful whether any real economy has been obtained by the use of a pressure evaporator. Whether or not it would pay an old factory to make these radical changes in order to obtain a greater economy is a matter of engineering and accounting.

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[1] *I.S.J.*, 1924, 557. [2] The patents for which were taken out in the name of A. Wernicke.

There is no doubt that some would be found that could well afford to make these changes and scrap the old equipment. High pressure evaporation is a step forward, and its adoption spells economy, and there is sufficiently convincing evidence in the available data which show that evaporating juices to a high temperature has a decided advantage, providing it is done in the proper apparatus.

COLLOIDAL ALUMINIUM COMPOUNDS FOR THE PURIFICATION OF JUICE. *E. Komm.* *Centralblatt für die Zuckerindustrie, 1924, 32, No. 36, 708.*

Besides Bachler's recently described method[1] there are two processes at present under consideration employing colloidal aluminium compounds, viz., that of HUNYADY and MALBASKI[2], using basic aluminium carbonate, and that of LINDNER, using aluminium hydroxide ("Aloidal"), obtained by treating aluminium salts with ammonia. In working the latter process, which has the greater possibilities, the colloidal clarifier is not added to the raw juice, but rather to the "fresh, still-living slices" after pulping and intimate admixture, so as to act on the concentrated cell juice in its unchanged state. Strictly speaking, it is therefore not a juice purifying process, but one that is applied for preparing the material from which the juice is extracted. Juice obtained from material so treated does not require the usual clarification with lime and carbon dioxide, and can be passed through low-pressure filters for elaboration subsequently to white sugar. An increase in the purity amounting to 4 to 5° is claimed. No statement of the amount of clarifying preparation, nor indeed of the cost of the process, is made, though it is claimed to be cheaper than ordinary working.

DEGUIDE PROCESS FOR THE DESACCHARIFICATION OF MOLASSES (BEET OR CANE). (*A*) *Albert Maurice, L'Ingenieur Chimiste, 1922, 6, No. 32, 1-12; 1924, 8, No. 44, 49-67.* (*B*) *H. W. Dahlberg. Facts about Sugar, 1924, 19, No. 7, 155-157.*

(*A*) DEGUIDE has worked out a process for the recovery of sugar in waste beet molasses, in which barium saccharate is precipitated from a hot solution of this product, filtered off, decomposed with carbon dioxide, the barium carbonate filtered off and recovered by his patented procedure (already described[3]) and the sugar in the filtrate worked up in the usual way. This recovery consists in the formation of the di-barium or tri-barium silicate by heating the carbonate with silica in a rotary kiln to 1300-1450°C., the silicate on treatment with water decomposing into monobarium silicate and barium hydrate, and the latter being used over again for the formation of barium saccharate. He computes the cost of his process as follows: 100 kg. of molasses (45 per cent. sucrose), 30 francs; 54 kg. of barium hydrate, 7·80; operating the saccharate process when using 100 kg. of molasses, 8·60; amortization in five years and interest on capital at 6 per cent. per 100 kg. of molasses, for a plant treating 50 tons of molasses per 24 hours, 2·00 francs, a total of 48·40 francs. A yield of sugar of 42·75 kg. would be obtained from the 100 kg. of molasses, so that the cost per kg. of sugar would be 48·40/42·75 = 1·13 francs. A sucrose recovery of 95 to 96 per cent. is claimed, and a baryta recovery in regenerating of 97 to 98 per cent. That is for beet molasses. Coming now to cane molasses, DEGUIDE dilutes the product with about four times its weight of water, adds baryta (twice the amount of reducing sugars), boils for about 2 min. to decompose the reducing sugars and other organic matter which would contaminate the saccharate cake, filters, concentrates the diluted molasses to about 20° Bé., and precipitates the sugar as barium saccharate by the addition of 130 kg. of barium hydrate per 100 of sucrose present, the temperature being kept at 80-82°C. for a few minutes, after which filtration follows. Lastly the saccharate is decomposed by treatment with carbon dioxide, the sucrose being liberated, and barium carbonate filtered off and regenerated as described. Working with Cuban molasses, a recovery of sugar of 90 to 92 per cent. was obtained, whilst the loss in regenerating the baryta was under 4 per cent. Waste liquors obtained after the separation of the saccharate could be concentrated to about 30°Bé., and incinerated in the Porion or similar furnace, the potash salts being leached out from the residue. (*B*) After discussing various processes for the desaccharification of beet molasses, Mr. Dahlberg concludes that in order that Deguide's above described tribarium silicate method should be successful in the U.S., it would have to fulfil the following conditions: There would have to be a large margin between the cost of sugar and that of molasses, and a tonnage of the latter sufficient to operate a plant all the year round; such a plant would have to be equipped with labour-saving devices developed to the last degree; and the impurities remaining after the separation of the sugar would have to be utilized by conversion to some form of marketable by-product.

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[1] *I.S.J.*, 1922, 220. [2] *I.S.J.*, 1924, 109. [3] *I.S.J.*, 1923, 51.

Action of Heat on Sucrose. (1) *A. Pictet and N. Andrianoff. Helv. Chim. Acta, 1924, 7, 703-707.* (2) *A. Pictet and P. Stricker. Ibid., 1924, 7, 708-713.* Through *J. Soc. Chem. Ind., 1924, 43, No. 44, B882.*

(1) When sucrose is heated at 185–190°C. at 10–15 mm. pressure, until it has lost 5 per cent. of its weight, a vitreous mass is obtained. This product, isosaccharosan (isosucrosan), $C_{12}H_{20}O_{10}$, when precipitated from methyl-alcoholic solution by addition of acetone, forms a perfectly white, hygroscopic, amorphous powder with a bitter taste. It has m.p. 94°–94·5°, $[\alpha]\ D^{22} = +64{\cdot}0°$, and rapidly undergoes hydrolysis to dextrose and levulose in aqueous solution. If the heating be continued until 10 or 15 per cent. of the weight is lost, caramelan, $C_{24}H_{36}O_{18}$, m.p. 144°–145°C., $[\alpha]\ D^{22} = +80{\cdot}0°$ in aqueous solution, or caramelene, $C_{36}H_{50}O_{25}$, m.p. 204°–205°C., $[\alpha]\ D^{23} = +65{\cdot}4°$ in aqueous solution, is obtained. (2) Isosucrosan may also be prepared by heating together at 185°C. and 15 mm. pressure, mixtures of dextrose and laevulosan, or glucosan and levulosan, respectively.

Determination of Sucrose, Dextrose, Levulose, and other Sugars by Formation of their Osazones. *Edmund Knecht and Eva Hibbert. Journal of the Chemical Society, 1924, 125, 2009-2012.*

In this direct method the glucosazone is formed, and the amount found volumetrically by reduction with excess of standard titanous chloride in presence of sodium tartrate, followed by back titration with crystal scarlet to ascertain the amount of reducing agent in excess. This is a method depending on a reaction occurring in stoichiometric proportions, differing therefore from the use of Fehling's solution, which method is based on factors determined empirically for each sugar. Sucrose (after inversion), dextrose, levulose, lactose, and maltose, can be determined by this method. Results in most cases showing almost the theoretical value are reproduced demonstrating its accuracy.

Behaviour of Sucrose on Heating [Production of Caramel]. *M. A. Rakusin and A. A. Nesmejanow. Zeitsch. Unters. Nahr. Genussm., 1924, 48, 151-152;* through *J. Soc. Chem. Ind., 1924, 43, No. 48, B 956.*

After heating sucrose for 30 min. at 180°C., it became optically inactive; after two hours at 150°C., the rotatory power was $[\alpha]_D = 13{\cdot}2$; and after four hours at 140°C., it was 21·0. For the production of caramel (suitable for medicinal use), sugar is heated in a test-tube to 200°C. until completely fused, care being taken to avoid the colouring of the melt; then the temperature is lowered to 160–150°C., which degree is maintained for two to four hours. The product thus obtained is optically inactive, has a sweet taste, and gives a positive reaction with Fehling's solution.

Inversion of Sucrose, and the Determination of the Hydrion Concentration. *M. Duboux. Helv. Chim. Acta, 1924, 7, 849-854.*

As the result of determinations on the hydrolysis of sucrose it is stated that the velocity of the reaction is not proportional to the hydrion concentration, and that to assume such proportionality may lead to an error of as much as 25 per cent.

J. P. O.

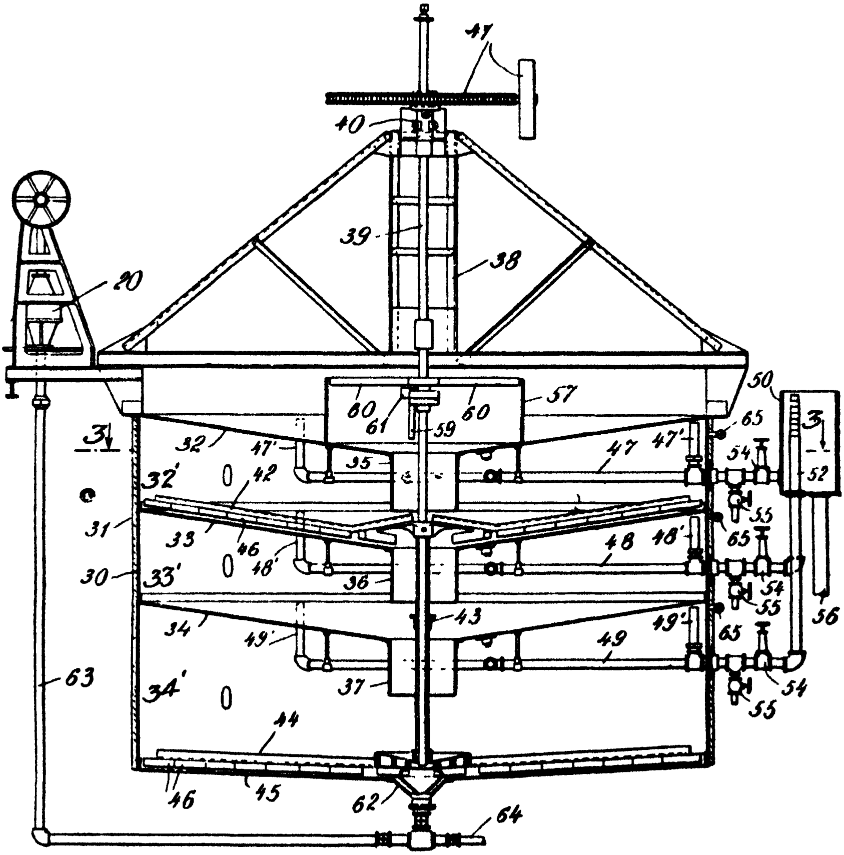
Review of Recent Patents.[1]

UNITED STATES.

GRAVITATIONAL SEPARATOR [OR CLARIFIER FOR USE IN THE DEFECATION OF CANE JUICE]. *John V. N. Dorr* (assignor to the *Dorr Company*, of Delaware, U.S.A.). *1,503,644*. August 5th, 1924

It is broadly the object of the present invention to provide improved means for separating the scum, clear liquor and mud which form during the defecation of cane juice, this being attained by the use of gravitational separators or "thickeners" of the tray type which operate continuously.

In the accompanying drawing, this separator comprises a cylindrical tank *30* having its sides and other exposed parts covered with a layer of heat-insulating material *31*. The interior of the tank is divided into a series of superimposed chambers *32'*, *33'* and *34'* by means of transverse partitions or trays *32*, *33* and *34* which form the respective top walls of these chambers. These trays are secured at their outer periphery to the side wall of the tank *30* and at their centres have an opening from which depends a boot *35*, *36* and *37*, respectively. The trays are preferably inclined and slope from the periphery towards



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

the opening at the centre thereof. The depending boots *35*, *36* and *37* are in alignment and form in effect a solids discharge path common to the three settling chambers within the tank. Above the tank is operatively mounted a superstructure or frame work *38*. A vertically disposed shaft *39* is rotatably carried in appropriate bearings *40* secured to the superstructure, and is arranged to be slowly revolved by a worm gear drive *41*. The shaft *39* extends downwardly through the boots *35*, *36* and *37*. Three pairs of radially disposed arms *42*, *43* and *44* are appropriately secured to the shaft *39* and arranged to revolve in proximity to the upper surface of the trays *33* and *34* and the inclined bottom *45* of the tank, respectively. Each of the radially disposed arms carries a series of ploughs or scrapers *46*, which are arranged to move settled solid material from the periphery of the settling chambers towards the central solids discharge outlet. Clear liquor is withdrawn from the upper part of each of the three settling chambers of the separator by means of decanting pipes *47*, *48* and *49*. The decanting pipes extend through the side wall of the tank and within the tank are substantially Y-shaped and have vertically positioned decanting connexions *47'*, *48'* and *49'*, respectively. The upper open ends of the decanting connexions *47'*, *48'* and *49'* are near the top of their respective settling chambers. These decanting connexions are moreover arranged near the outer circumference of the settling chambers. The decanting pipes *47*, *48* and *49* are arranged to discharge into a sump *50*. The decanting pipe *47* communicates directly with this sump near the bottom thereof, while the decanting pipes *48* and *49* communicate with the sump through vertical standpipes. The upper or outlet ends of the standpipes are adjustable, and by varying the height of these standpipes the rate of flow of material through the separator can be appropriately adjusted. Outside the tank, the decanting pipes are provided with shut-off cocks *54* and separate outlet cocks *55*. The sump *50* has a discharge pipe *56*. The tray *32* forms, in effect, the top of the separator. A cylindrical drum *57*, considerably smaller in diam. than the tank *30*, is secured above the tray *32* and provides a loading well into which the mixture of juice and solid material is fed through an inlet pipe. The discharge opening of the inlet pipe is tangentially arranged with respect to the loading well, so that the mixed juice and solids receive a whirling motion when fed into the well. A transverse baffle *59* is arranged opposite the inlet pipe. Near the top of the drum *57* are arranged a pair of skimming arms *60* These arms are secured to and rotate with the shaft *39* A launder or trough *61* is positioned below the plane of the skimmers *60* and serves for the discharge of scum and foam. The bottom *45* of the tank is inclined, although its inclination is somewhat less than that of the superimposed trays. At its centre the bottom has a discharge cone *62* communicating with a solids discharge pipe *63*. The pipe *63* is connected with a diaphragm pump *20*. A high pressure supply line *64*, of water or air, is connected to the solids discharge outlet of the tank and serves to flush the discharge cone *62* or the pipe *63* in the event that either of these elements becomes clogged with solid material.

In the operation of the separator, the mixed juice* and solids coming from the heaters enter the loading well at the top of the separator through the feed pipe *58* in such a way as to receive a whirling motion. Certain of the solids are of less specific gravity than the juice, such for example as air-carrying particles of cellulose, waxes and gums, and tend to rise if given time. As a result of this whirling motion the juice moves downwardly at a uniform rate throughout the whole of drum *57*, local currents are broken up and the whole of the juice is retained long enough to give the floatable material time to rise and be pushed into the trough *61* by means of the revolving skimmers *60* which rotate with the whirl created by the tangential feed. The boot *35* adds to the effective depth of the loading well. In initially filling the separator, air ports *65* in the side walls of the tank are opened to permit the escape of air displaced by the incoming mixed juice and solids. Juice and solids pass slowly through the boots *35*, *36* and *37*, and that portion of the solids not passing directly through these boots to the bottom of the tank settles on the trays *33* and *34* and the bottom *45* and is worked or pushed towards the common solids discharge path by means of the revolving ploughs or scrapers *46*. All solids thus find their way to the discharge cone *62* at the bottom of the separator where they are withdrawn by the action of the diaphragm pump *20* as a heavy mass or sludge with a limited amount of juice.

EVAPORATOR HEATING SYSTEM. *Clark D. Levermuth*, of Donaldsonville, La., U.S.A. *1,496,387*. March 11th, 1924.

In the previous systems of evaporators for cane syrups, etc., there has been no defined path of liquor circulation, except that the liquor flowed up through the smaller tubes and returned through the larger ones. The difficulty with such systems has been that the average density of liquor in contact with the heating surface has been nearly equal to the final density and the coefficient of heat transmission has therefore been low. According to the present invention, in one and the same unit the liquor is subjected to the action of a heating medium of one temperature, that is, heat is transmitted thereto in a single vapour or steam phase, and a defined circulation provided for the liquor under treatment. In the full embodiment of the invention, the liquor is caused to flow through several paths, passing progressively from one compartment to another, each successive compartment containing more dense liquor. The average density of evaporated liquor in contact with the heating surface is much less than the average density in contact with the heating surface in former devices, and therefore the coefficient of heat transmission in the present case is much greater and the apparatus is more efficient in operation. So far as the inventor is aware, this is the first instance where the liquor has been compelled to circulate in more than one defined path, or where the evaporated liquor has been compelled to travel progressively from one compartment or body of liquor to another of greater density, so that the average density of all the liquor in contact with the heating surface is less, thus securing a greater coefficiency of heat transmission. It will be obvious that where the fresh liquor has been added to a single compartment containing the only body of liquor, and where the evaporated liquor has been taken from this same body, that the average density of the liquor in contact with the heating surface must necessarily be about the same as the finished product and that in such apparatus there cannot be an efficient transmission of heat to the liquor. In the present apparatus this defect is overcome.

EVAPORATING APPARATUS, IN WHICH THE LIQUID IS "ATOMIZED" INTO A HEATED CHAMBER. *Richard G. Brindle*, of Chicago, Ill., U.S.A. (assignor to *Corn Products Refining Co.*, of New Jersey, U.S.A.). *1,491,026*. April 22nd, 1924.

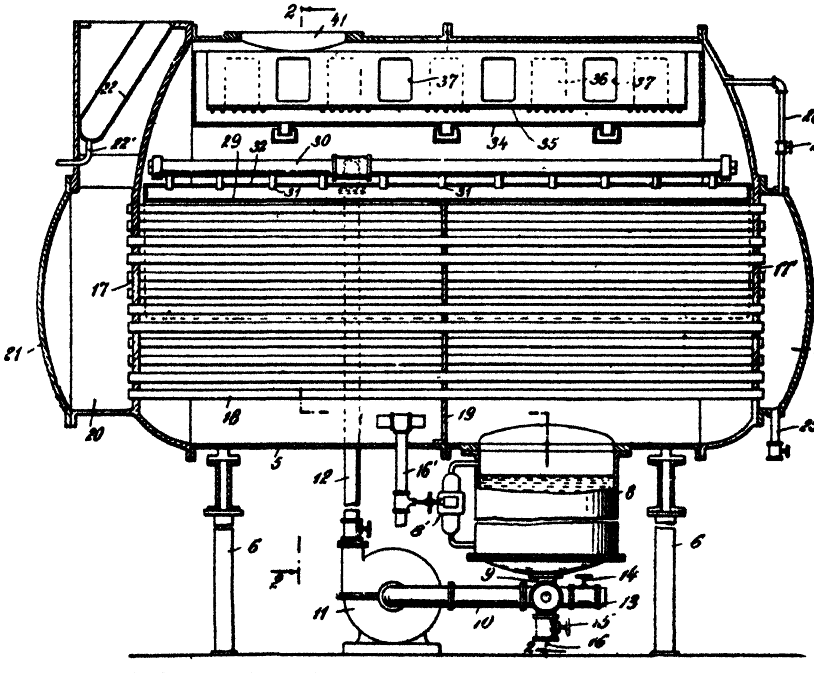
In apparatus for the evaporation of solutions or liquids containing solid substances in suspension, the combination of an evaporation chamber, a spray nozzle in the bottom of the evaporation chamber for spraying the liquid to be treated upwardly through the chamber, a duct surrounding the evaporation chamber above the spray nozzle adapted to receive air from said air heating device and having ports to deliver said air into the chamber, a dust collector, and means for withdrawing air from the top of the chamber into said dust collector, a heat transferring device having a passage for the circulation therethrough of fresh air, and a passage for air drawn from the evaporation chamber, a duct connecting said dust collector with said last named passage, a branch duct leading from said last named duct to the bottom of the evaporation chamber, a dust collector through which air from the evaporation chamber is passed after circulating through the heat transferring device, and a duct for introducing the fresh air circulated through the heat transferring device into the duct surrounding the evaporation chamber.

CANE STRIPPING MACHINE. *Henry O. Scranton*, of Jeanerette, Louisiana, U.S.A *1,491,070*. April 22nd, 1924.

Claim 3:—In a stripping machine, a series of stripping devices arranged horizontally side by side, cutting mechanism for topping the canes arranged to one side of and above the level of the stripping devices, and an inclined bar for guiding the cane laterally into and through the cutting mechanism and thence downwardly to a position in line with the stripping device at one end of the series, said bar having a series of notches arranged horizontally at its lower end and spaced apart to correspond with the series of stripping devices.

FILM EVAPORATOR. *Burton S. Hughes* (assignor to the *Zaremba Company,* of Buffalo, New York, U.S.A.). *1,506,001.* August 26th, 1924.

Film evaporators as heretofore constructed have been subject to certain disadvantages which are here overcome in a simple and effective manner. Thus, the inventor has discovered that the efficiency of film evaporators may be materially increased by causing the vapour, resulting from the heating effect of the tubes, to flow downwardly or in the direction of the flow of liquid. The vapour, thus travelling with the liquid, escapes about the lower edges of confining walls into the vapour space of the evaporator and is eventually withdrawn from the evaporator free from entrained liquid. The liquid passes into a collecting chamber from which it is withdrawn and returned, through a suitable pump, to the evaporator and again descends over the tubes, circulation being maintained until the required concentration is accomplished. Referring to the drawing, *5* indicates the shell of the evaporator, which is preferably cylindrical and may be constructed of cast-iron, steel, copper or other suitable material. The shell is supported on columns *6* and is preferably elevated *8* or *10* feet above the floor level. A receiving chamber *8* is arranged beneath the shell, to receive and maintain a supply of the liquid to be evaporated. An outlet *9* at the bottom of the receiving chamber permits withdrawal of the liquid, which is delivered through a pipe *10* to circulating pump *11* and returned to the shell *5* through a pipe *12*. A suitable pipe *13* is connected to the outlet *9* and controlled by a valve *14* to permit withdrawal of the liquid when a suitable concentration thereof has been accomplished. A valve *15* controls a washout drain *16* which is also connected to the outlet *9*. Liquid is admitted through an inlet pipe *16′* controlled by an automatic regulator. The shell *5* is provided at opposite ends with tube sheets *17* and *17′* in which the tubes *18* are supported. Preferably an auxiliary support *19* for the tubes is disposed with in the shell midway of the longitudinal axis thereof. A steam chest *20* is formed at one end of the shell *5* and is closed by a removable cover *21* giving access to the ends of the tubes. The steam chest *20* is provided near its upper end with a baffle *22* with free spaces thereabout against which the entering steam or vapour impinges, and which causes



any liquid entrained therein to separate, and return to the steam boiler or a preceding effect of the evaporator through a pipe *22'*. The tubes *18* are preferably slightly inclined to the horizontal so that the condensate drains therefrom into a chamber *23* at the end of the shell *5* opposite the steam chest *20*. The chamber *23* is formed by a removable cover *24* which may be separated from the shell to give access to the tubes. A drain *25* is connected to the chamber *23* to remove the condensate and a vent *26* provided with a valve *27* is arranged to permit noncondensibles in the vapour, passing through the tubes *18*, to enter the shell *5*. The nest of tubes *18* is axially arranged within the shell *5* and is partially enclosed by baffle walls extending longitudinally of the shell *5*, and suspended from the liquid distributor *29*, to which the liquid is delivered through a distributing pipe *30*, having a plurality of nozzles *31* and being adapted to receive the liquid from the pipe *12*. The bottom of the distributing pan *29* is perforated so that the liquid delivered thereto is eventually distributed over the upper tubes *18*. The liquid thus distributed descends over the succeeding tubes in contact with the heated surfaces thereof and is evaporated by heat-interchange with the heating fluid. The distributing pan *29* is closed by a cover *32* which prevents the natural upward movement of the vapour formed, and the baffle walls cause the vapour to follow the downward path of the liquid until the vapour passes beneath the lower edges of the baffle-plates. A plurality of ribs is arranged longitudinally of the shell *5* and is adapted, as the vapour flows upwardly after escaping the baffle walls to cause any entrained moisture to separate and flow downwardly with the evaporated liquid to the receiving chamber *8*. As a further insurance against the escape of entrained liquid with the vapour, baffle-plates *34* and *35* are arranged and are provided with staggered openings *36* and *37*. The baffle-plates *35* carry ribs against which the vapour impinges in its passage from the inlet openings *36* to the outlet openings *37*, thus causing any entrained moisture to separate. A plurality of drains is provided to permit the escape of the liquid thus separated, and a trap is provided at each drain, to prevent vapour from escaping from the interior of the shell *5*, except through the openings *36* and *37*. An outlet *41* permits the final escape of the vapour from the shell.

CUBE SUGAR PACKING DEVICE. ***Henry Dippel***, of San Francisco, Cal., U.S.A., *1,508,837*. September 16th, 1924.

Claim 1: A device of the character described comprising a base plate, a pair of gripping plates mounted thereon, means for opening and closing the plates in unison, and a pusher plate disposed between the gripping plates.

DECOLORIZING CARBON. (*A*) ***Clarence P. Wilson*** (assignor to ***California Fruit Growers' Association***, of California, U.S.A.). *1,498,708*. June 24th, 1924. (*B*) ***J. N. Leadbeater***, of Doncaster, England. *1,510,284*. September 30th, 1924. (*C*) ***Arthur A. Backhaus*** (assignor to ***U.S. Industrial Alcohol Co.***, of West Virginia). *1,610,131*. September 30th, 1924.

(*A*) Claim is made for the combined operations of mixing together porous refractory material and organic matter, applying pressure to the mixture to cause thorough impregnation of the two materials, and then applying sufficient heat to the mass to drive off the volatile matter and cause the deposition of a decolorizing carbon within the refractory material. (*B*) Finely divided peat is dried, mixed with finely divided crushed lime, and carbonized by heating, the residue being treated with an inorganic acid to remove the ash and foreign substances, and the cleaned carbon mixed with infusorial earth, and heated. (*C*) Molasses distillery waste is evaporated to about 25-30° Bé., in sufficient quantity to prevent foaming in the retort, and heated to 750°C., steam being introduced before and near the end of the operation to remove volatile materials.

CANE MILL (SMALL, FOR HORSE POWER). ***Lee H. Dillman***, of Agra, Okla., U.S.A. *1,489,486*. April 8th, 1924.

UNITED KINGDOM.

ELECTRO-OSMOTIC PURIFICATION OF JUICE. *Elektro-Osmose A.-G. (Graf Schwerin Gesellschaft)*, of Berlin, Germany. *214,578.* January 4th, 1924; convention date, April 18th, 1923.

A known process for purifying saccharine juices electro-osmotically consists in submitting the juice to the action of a direct electric current between diaphragms, in which the anodic diaphragm has a positive potential, thereby allowing negative ions to pass through it, whilst the cathode diaphragm has a negative potential, thereby allowing positive ions to pass through it. The practical application of this process, however, involves a number of difficulties, particularly in the selection of the diaphragms. On the one hand, there often occurs an undesirable dilution of the solution contained in the middle compartment due to cathodic or anodic migration of water; on the other hand, both on account of the dimensions of the pores and the electric charge of the diaphragms used, losses of valuable substances occur owing to their migration from the middle compartment to the side chambers. In the electric-osmotic purification of saccharine juices there is also the additional practical difficulty that the formation of invert-sugar can only be avoided by keeping the juice neutral or slightly alkaline. The latter consideration is closely connected with the choice of the diaphragms for use in the process. A number of proposals have already been made relating to diaphragms suitable for the process. As an anodic diaphragm, one made of albumin has been used, and as a cathodic diaphragm one of cellulose, but none of these overcomes the above-mentioned defects. It is, moreover, impracticable to select quite empirically from the large number of combinations of diaphragms that combination which is most suitable for the process in question. By the present invention, however, saccharine juices can be electro-osmotically purified in a manner which fulfils practical requirements and is free from the above-mentioned defects, and this is done by using an anodic diaphragm of quinone-tanned leather, and a cathodic diaphragm of closely woven sail-cloth. According to the invention the quinone-tanned leather diaphragm may be prepared as follows:—Hides which have been cleaned and delimed are placed in a rotary tanning cask about one-third full of an aqueous solution of quinone of about 0·4 per cent. strength. The cask is rotated for about 2–4 hours, at the end of which time the thorough impregnation is generally completed, and a section of the leather should be dark-violet. Finally, the leather is thoroughly washed. Before use as a diaphragm, the leather is immersed in boiling water for at least one hour, in order to promote shrinking so that the pores may be reduced to the requisite size.

EXTRACTION OF (BEET) JUICE USING EXTRUSION PRESSES. *H. M. Lamy-Torrilhon*, of Paris, France. *210,061.* December 27th, 1923; convention date, January 29th, 1923.

In extrusion presses for extracting juice from beets (and pasty or semi-liquid materials), the cage is made of bars fitted within pairs of hoops and jammed by wedges. The cage may be cylindrical or conical, and may be made long by arranging sets of bars end to end. In the latter case it may be narrowed in parts as by using bars wider at one end than another or by inclining the bars by wedges.

REMOVING INCRUSTATION FROM TUBES OF EVAPORATORS, BOILERS, ETC. *S. Sorensen*, of Port Richmond, New York, U.S.A. *219,174.* July 23rd, 1923.

A power-operated hammer for use in removing incrustation from boiler tubes and the like, of the type comprising a head forming a cylinder and a power piston operable therein, has the piston formed with two enlarged portions acting as valves and two hammer portions which are projected alternately through openings in the head. The central chamber between the enlarged portions of the piston forms a power supply chamber alternatively to passages which communicate also by passages to the two end chambers respectively. Exhaust passages are provided at the rear of the head and also lateral exhaust passages.

EVAPORATOR (KESTNER FILM TYPE). *Soc. Anon. Appareils et Evaporateurs Kestner,* of Lille, France. *218,556.* November 26th, 1923; convention date, July 25th, 1923.

In evaporators of the Kestner type in which liquid, fed to the base, rises through a nest of vertical steam-heated tubes to an upper vapour-separating chamber, the tubes are arranged so as to form distributing channels in the inlet chamber for the more uniform feed of liquid to the separate tubes.

DEHYDRATING ALCOHOL.[1] *Distilleries des Deux-Sèvres* (formerly *Soc. Ricard, Allenet, & Cie.*), of Melle, Deux-Sevres, France. *218,662.* July 2nd, 1924; convention date, July 6th, 1923.

Relates to dehydrating alcohol by distillation in presence of an added liquor as described in Specification 211,451[2]. (1) A mixture of two liquids, for example, a mixture of benzene and of gasoline boiling at about 100°C. may be made use of. (2) Water is added to the distillate to effect, in the case where ethyl acetate is used as added liquid, a separation into two layers, and in the case where gasoline is used as added liquid, a more complete separation of gasoline from the lower layer.

PROCESS OF MANUFACTURING OR REFINING SUGAR. *L. Alves do Cunha,* of Formosa, Oporto, Portugal. *218,983.* May 23rd, 1224; convention date, July 10th, 1923.

Sugar syrup is concentrated in an open evaporating pan, and the concentrated and crystallized syrup is crushed in an annular steel pan by means of a conical bronze roller, carried on one of a set of arms on a rotary spindle, the pressure of the roller on the sugar being regulated by means of a wheel. Another arm carries scrapers.[3]

CLARIFICATION OF JUICES AND SYRUPS, USING ADSORBENT SALTS AND PRECIPITATES.[4] *J. N. A. Sauer,* of Amsterdam, Holland. (*A*) *222,159.* March 26th, 1923. (*B*) *222,423.* March 26th, 1923.

(*A*) Calcium salts having adsorbent properties suitable for the treatment of sugar solutions (or oils and of gases and vapours) are prepared by converting calcium oxide or hydroxide into an insoluble salt, by treatment with an acid in presence of an alkali metal hydroxide or salt, or with a large excess of an alkali salt with subsequent treatment of the solution remaining by an acid to regenerate the alkali salt. Calcium salts mentioned are the carbonate, sulphite, sulphate, phosphate, oxalate and tartrate, the particular description relating to the production of carbonate. Milk-of-lime, mixed with a solution of potassium or sodium carbonate or hydrate, is treated with carbon dioxide at 90° C. or higher. The precipitate may be washed with various liquids, and various substances (starch, tannin, etc.) may be mixed with it to prevent the particles from adhering one to another. Alternatively finely-divided lime or milk-of-lime, together with caustic alkali or alkali carbonate is distributed in a chamber into which carbon dioxide is admitted together with steam or superheated steam preferably under pressure. Calcium sulphite may be made by employing sulphur dioxide in this process, and calcium sulphate by employing sulphur dioxide and sufficient superheated steam. Or a large excess of sodium carbonate is added to milk-of-lime, an excess of 25 or 50 per cent. being suitable; and before or after the separation of the precipitate the solution is treated with carbon dioxide or flue gases to convert the caustic soda formed into carbonate for re-use. [Specifications *183,485*[5] and *184,473*[6] are referred to.] (*B*) Composite adsorbent precipitates, suitable for the treatment of liquids such as sugar solutions and of gases, are prepared by precipitating an alkaline earth salt and depositing upon it another alkaline earth salt, under such conditions as to produce precipitates having adsorbent properties, the precipitation being preferably effected above

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[1] See also *I.S.J.*, 1924, 504. [2] *Ibid.*

[3] A brief abridgment only is available at the present date of this patent, which is not yet accepted.

[4] Compare also *I.S.J.*, 1923, 273, 501. [5] *I.S.J.*, 1923, 273. *Ibid.*

80°C. A precipitate of calcium carbonate may be prepared and a coating of dicalcium phosphate produced upon it by adding a small quantity of phosphoric acid. If the precipitate is to be dried, substances may be admixed with it to prevent the particles agglomerating. Such substances may be tannin, starch, glue, or soda or, when it is to be used for the treatment of sugar solutions, sugar may be used as the addition. A relatively expensive precipitate such as calcium phosphate, citrate, tartrate, oxalate or sulphite may be precipitated upon a relatively cheap precipitate such as calcium carbonate. [Specifications *183,485*, *184,473*, and *222,159* (above) are referred to.]

Expressing Liquids from Moist Materials. [Extraction of Juice from Beet and Cane.] *O. Soderlund, T. Boberg, N. Testrup, and Techno-Chemical Laboratories, Ltd.*, of Clapham Park, London. *220,015*. March 7th, 1923.

In expressing liquid from moist material by pressure between rolling surfaces, the contents of the entry cavity between a pair of rolls is divided to form a plurality of films by a series of travelling partitions moved through the bite of the rolls together with and by the co-operation of the material. The apparatus is applicable for the extraction of oil or fats from seeds, beans and nuts, and for the treatment of peat, lignite, moss litter, sewage, spent hops, brewers' grain, vegetable extracts, sugar cane, beet chips, wood pulp, and sawdust. Further drying of the pressed material may be effected by carriage in a heated gaseous medium described in U.K. Specification *150,807*. [Specifications *20,351/00* and *28,456/04* are also referred to.]

Centrifugal with Charging and Discharging Devices. *W. C. Roos*, of Pemalang, Tegal, Java. *222,143*. September 20th, 1924; convention date, September 20th, 1923.

A separator for separating solids from liquids, particularly for separating crystalline sugar from massecuite, consists of a drum *3* of gauze supported from the cone *2*. A pipe *6* with a mouthpiece *7* having a vertical slot directed towards the inner side of the drum conveys the material to be treated. This material may be diluted and heated, and forms a very thin layer on the drum owing to the high speed of rotation. The liquid passes through the gauze, is removed by external wipers *12* and passes from the trough *5* to the discharge pipe *14*. The solids are removed from the gauze by the suction pipe *10* before a full revolution is made after their deposition. Steam is blown through the pipe *11* to assist the release of the crystals from the drum. Scrapers may be used instead of the suction pipe *10*.

FIG.1.

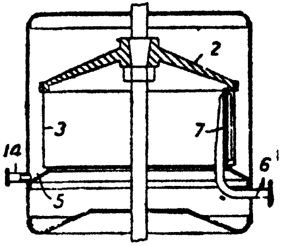
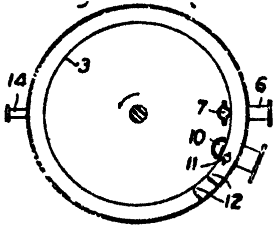


FIG.2.



Recovery of Nitrogen and Acetone from Molasses and Distillery Vinasse *Syndicat d'Études Chimiques*, of Brussels, Belgium. *208,516*. October 25th 1923; convention date, December 15th, 1922.

Claim is made for the "process for the recovery of nitrogen and acetone from molasses and vinasses, characterized by the application of pyroligneous distillation *in vacuo*, or under reduced pressure, with addition of lime or any alkaline-earth base, for the purpose of recovering the contained nitrogen, obtaining other by-products not hitherto collected industrially, viz., acetone, acetonic oils, and non-nitrogenous tar, and leaving a distillation residue for subsequent treatment in any suitable manner."

Sugar Crops of the World.

(Willett & Gray's Estimates to November 26th, 1924.)

	Harvesting Period.	1924-25. Tons.	1923-24. Tons.	1922-23. Tons.
United States—Louisiana	Oct.-Jan.	100,000	144,664	263,478
Texas	,, ,,	700	2,500	2,875
Porto Rico	Jan.-June	464,000	397,740	338,456
Hawaiian Islands	Nov.-July	590,000	620,000	479,463
West Indies—Virgin Islands	Jan.-June	2,500	2,332	1,739
Cuba	Dec.-June	4,300,000	4,066,642	3,602,910
British West Indies—Trinidad	Jan -June	50,000	52,045	41,619
Barbados	,, ,,	53,000	44,109	52,715
Jamaica	,, ,,	42,600	33,431	33,029
Antigua	Feb.-July	13,000	7,860	12,642
St. Kitts	Feb.-Aug.	13,000	10,196	10,735
Other British West Indies	Jan.-June	9,000	4,488	5,292
French West Indies—Martinique	Jan.-July	23,000	17,000	19,700
Guadeloupe	,, ,,	34,000	27,548	25,043
San Domingo	Jan.-June	240,000	229,373	184,171
Haiti	Dec.-June	7,000	5,800	10,967
Mexico	,, ,,	165,000	166,932	119,457
Central America—Guatemala	Jan.-June	24,000	20,850	24,445
Other Central America	,, ,,	65,000	56,000	50,336
South America—				
Demerara	Oct.-Dec. and May-June	100,000	95,494	101,128
Surinam	Oct. Jan.	10,200	10,682	11,719
Venezuela	Oct.-June	19,000	17,488	16,840
Ecuador	Oct.-Feb.	18,700	13,662	14,220
Peru	Jan.-Dec.	300,000	326,352	313,743
Argentina	May-Nov.	240,000	257,349	209,718
Brazil	Oct.-Feb.	500,000	425,000	595,723
Total in America		7,383,700	7,055,537	6,542,163
Asia—British India	Dec.-May	2,900,000	3,266,000	3,044,000
Java	May-Nov.	1,972,000	1,771,772	1,746,875
Formosa and Japan	Nov.-June	460,000	448,736	405,800
Philippine Islands	,, ,,	462,000	372,000	263,437
Total in Asia		5,794,000	5,858,508	5,460,112
Australia	June-Nov.	350,000	281,859	306,678
Fiji Islands	,, ,,	70,000	58,000	37,154
Total in Australia and Polynesia		420,000	339,859	343,832
Africa—Egypt	Jan.-June	110,000	88,382	94,554
Mauritius	Aug.-Jan.	237,000	201,550	231,190
Réunion	,, ,,	43,500	44,132	42,872
Natal	May-Oct.	160,000	181,571	142,287
Mozambique	,, ,,	70,000	60,000	45,950
Total in Africa		620,500	575,635	556,853
Europe—Spain	Dec.-June	8,000	7,871	13,918
Total cane sugar crops		14,226,200	13,837,410	12,916,878
Europe—Beet sugar crops		6,961,000	5,057,761	4,574,325
United States—Beet sugar crop	July-Jan.	875,000	787,217	615,936
Canada—Beet sugar crop	Oct.-Dec.	20,000	16,500	12,400
Total beet sugar crops		7,856,000	5,861,478	5,202,661
Grand total Cane and Beet Sugar	**Tons**	**22,082,200**	**19,698,888**	**18,119,539**
Estimated increase in the world's production	**,,**	**2,383,312**	**1,579,349**	**513,753**

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to November 26th	2,876,386	..	2,738,085
Deliveries „ „	2,874,250	..	2,732,807
Meltings by Refiners „ „	2,860,660	..	2,684,380
Exports of Refined „ „	190,000	..	195,000
Importers' Stocks, November 26th	2,930	..	5,278
Total Stocks, November 29th	7,034	..	14,253
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23. Tons	1923-24. Tons.
Exports	3,594,173	3,386,494	3,736,359
Stocks	223,397	86,266	145,422
	3,817,570	3,472,760	3,881,781
Local Consumption	125,000	108,000	115,000
Receipts at Ports to October 31st	3,942,570	3,580,760	3,996,781

Havana, October 31st, 1924. J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to November 26th, 1924.)

	Harvesting Period.	1924-25. Tons.	1923-24. Tons.	1922-23. Tons.
Germany	Sept.-Jan.	1,640,000	1,146,891	1,455,078
Czecho-Slovakia	Sept.-Jan.	1,450,000	1,001,049	734,856
Austria	Sept.-Jan.	68,000	47,321	24,468
Hungary	Sept.-Jan.	200,000	122,588	81,603
France	Sept.-Jan.	800,000	490,850	492,705
Belgium	Sept.-Jan.	375,000	300,121	268,928
Holland	Sept.-Jan.	330,000	231,923	255,592
Russia (Ukraine, etc.)	Sept.-Jan.	430,000	366,742	193,400
Poland	Sept.-Jan.	450,000	389,995	301,890
Sweden	Sept.-Jan.	143,000	153,890	71,790
Denmark	Sept.-Jan.	140,000	102,358	88,382
Italy	Sept.-Jan.	360,000	351,102	297,280
Spain	Sept.-Jan.	255,000	185,063	160,035
Switzerland	Sept.-Jan.	6,000	5,500	6,033
Bulgaria	Sept.-Jan.	40,000	26,566	16,250
Roumania	Sept.-Jan.	90,000	71,826	49,872
England	Sept.-Jan.	21,700	13,280	7,011
Other Countries	Sept.-Jan.	162,300	50,696	69,152
Total in Europe		6,961,000	5,057,761	4,574,325

United Kingdom Monthly Sugar Report.

Our last Report was dated the 10th November, 1924.

The market maintained a steadier tone throughout the earlier part of the period under review, but on reports of still further increased estimates of both beet and cane crops it developed further weakness, and prices for both actual sugar and paper are easier.

Business in the terminal market has been in narrow limits. Speculation has not been induced to come in at this level of prices and consequently the offers from the Continent have not readily been absorbed except at lower prices. November was finally liquidated at 19s. 6d. There were roughly 10,000 tons tendered in settlement of November contracts, and this sugar pressed rather heavily on the market in the absence of trade support. Dealings in December were fairly heavy and this month was traded in from 18s. 6d. to 19s. 1½d. to 18s. 1½d. ; business was done in March from 18s. 7½d. to 19s. to 17s. 10½d. ; in May from 18s. 10½d. to 19s. 3d. to 18s. ; and in August from 18s. 10½d. to 19s. 4½d. to 18s. 1½d. The latest prices are December 18s. 3d. ; March 17s. 10½d. ; May 18s. ; August 18s. 1½d.

Trading in actual sugars was fairly brisk at the outset, and there was a good general demand from the trade. Continental supplies became more abundant ; and, although U.K. buyers were fulfilling their requirements on a hand to mouth basis, their stocks were so low that the increased Christmas demand at this season of the year absorbed all these offers for a time. During December, however, the demand fell off considerably and prices have sagged. There is no demand at all for export. Fine Granulated on the spot rose from 33s. 6d. to 34s. ; but to-day is quoted at 32s. 3d. White Javas on the spot are all cleared, but some business has been done in May/August shipment at 19s. to 18s. 6d. c.i.f. U.K. Continental Granulated for ready and prompt shipment has been more abundant, owing to some Russian contracts in Czecho marks have fallen through, Dutch sold from 20s. to 20s. 6d. to 19s. 6d., and Czecho sold from 19s. 6d. to 20s. 6d. to 19s. American Granulated is naturally out of parity with the U.K. Market, and was not offered ; Dutch Granulated for December was sold at 19s. 9d. to 20s. to 19s. ; and second-hand offers of Dutch were made as low as 19s. 3d. up to next June. Czecho Granulated for December sold from 19s. 4½d. to 19s. 9d. to 19s., and offers of January/March were made at 18s. 9d. Belgium Granulated and Crystals for December were dealt in at 19s. German Granulated was not offered, but isolated lots of Castor were sold at 20s. to 20s. 6d.

The British Refiners are still experiencing great difficulty in obtaining raws at competitive prices. On November 13th they reduced their prices by 1s. per cwt., but on November 21st their prices were advanced 6d., and a further advance of 6d. per cwt. was established on November 27th. On December 5th their prices were marked down 6d., and the latest quotations are : No. 1. Cubes 39s. ; and London Granulated 35s. 4½d.

Business in raws has been difficult, and almost entirely confined to Perus afloat at 17s. and in 88 per cent. Beet at 16s. 3d. and 16s. 9d. Some sellers of 88 per cent. beet for November actually defaulted and placed the Refiners in a further quandary. A very limited business was done in Cuban 96 per cent. for February/March at 15s.

The demand for Refined in America was not so brisk, although raws are still tightly held and the Refiners were forced to pay up to 4⅜ cents. for prompt 96 per cent. Cubans for next year could be bought at 3 cents. c.i.f. December Futures have advanced to 4·15 and March to 3 cents.

Mr. F. O. Licht has further increased his estimate for the European crops as follows :—

	Tons.		Tons.
Germany	1,640,000	Spain	255,000
Czecho Slovakia	1,500,000	Hungary	200,000
France	800,000	Sweden	140,000
Poland	450,000	Denmark	140,000
Russia	450,000	Austria	68,000
Italy	420,000	Other Countries	375,000
Belgium	375,000		
Holland	330,000	Total	7,143,000

Various estimates have been made with regard to the forthcoming Cuban crop between 4,300,000 tons and 4,500,000 tons; but to-day Mr. Himely has brought out his first estimate, viz., 4,620,000 tons, against a crop last year of 4,066,642 tons.

21, Mincing Lane,
London, E.C. 3.
December 9th, 1924.

Arthur B. Hodge,
Sugar Merchants and Brokers.

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